

English
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SERVICE MANUAL FOR FREQUENCY CONTROL SYSTEM





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Read the instructions supplied with the product before installation and commissioning.



Keep the instructions in a safe place for future reference.

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1 CAUTION



This manual rev6.0 is for inverter rev 1.0 with software D2S2V051.



Before starting, read the instructions carefully.



Verify all of the connections are in accordance to the drawings.



Verify the motor supply is connected correctly, faulty connection will destroy the inverter.



Check the device cover is properly installed.



High voltages are present in this device. Switch the power off and after the display turns off, wait 5 minutes before opening the cover.



Insulation resistance test with a megger multimeter requires special precautions.



Do not make any measurements inside the device when it is connected to the main supply.



Do not touch the components on the circuit boards. Electrostatic discharge may cause damage or destroy the IC-circuits.



Check all ventilation holes are clear and unobstructed.



Check that hot air coming from the brake resistors does not cause any danger.



Do not make any inspections unless the supply has been disconnected by the main switch.



It is forbidden to use radiophones or portable phones near this device with the doors open.



All the doors and covers must be closed during crane operation.



Drive is not intended to be used in a low-voltage public network, which supplies domestic premises. Radio frequency interference is expected if used in such a network.



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2 GENERAL

2.1 Technical data

| | 002F | 003F | 004F | 005F | 007F | 011F | 015F | 018F | 022F |
|-----------------------------------|------|------|------|------|------|------|------|------|------|
| Power class | | | | | | | | | |
| Power (kVA) at 400V | 3.5 | 5.5 | 7.0 | 9.0 | 13 | 17 | 22 | 29 | 33 |
| Output current I _n (A) | 5.0 | 8 | 10 | 13 | 18 | 24 | 32 | 42 | 48 |
| Max. current 1min (A) | 7.6 | 12 | 15 | 20 | 27 | 36 | 48 | 63 | 72 |

Overload ability 1.5 x I_n, 1min/10min
Max. output voltage Equals to supply voltage

Supply

Supply voltage 380-500Vac
Allowable voltage fluctuation +/- 10%
Nominal supply frequency 50/60Hz +/- 5%

Signal input levels

Digital controls S1, S2, DID3, DID4, DID5: 42 ... 240Vac; 15mA

Control features

Control method Open loop vector control
Frequency control range 0 ... 250Hz
Frequency command Electronic potentiometer, 2-5-step controller or 0 ... 10V analog signal
Limit switch functions Slowdown and stop limit inputs for both directions
Speed control range s_N ... 100% (s_N= motor nominal slip)
Speed accuracy 1% of nominal speed at speed range 10 ... 100%
1/3 of motor nominal slip at speed below 10%
Braking torque 150%

Protections

Motor overload protection Thermistor or Klaxon thermostat based temperature measurement
Overload protection Fault is detected if the current momentarily exceeds 280% of rated current
Undervoltage / blown fuse Fault is detected if DC voltage drops below 333V
Overvoltage protection Fault is detected if DC voltage exceeds 911V
Momentary power loss Immediate fault stop
Inverter overtemperature Temperature sensor on the heat sink
Mechanical brake Circuit breaker (from 007 upward)
Ground fault Provided by electronic circuitry

Ambient conditions

Ambient temperature -10°C ... +50°C (14°F ... 122°F) for ED≤40%
Storage temperature -40°C ... +70°C (-31°F ... 158°F) dry
Humidity <95%RH (no condensation)
Altitude Maximum 1000m at I_n. Above 1000m: I_n reduces 1% per each 100m.
Above 3000m: consult factory.
Vibration Operation: maximum displacement amplitude 3mm at 2-9Hz.
Maximum acceleration amplitude 0.5g (5m/s²) at 9-200Hz

Conforms to LV and EMC directives.



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2.2 Basic description

| | |
|-------------------------------|--|
| Inverter | The specific crane features for the inverter hardware and the special software are achieved by combining the experience and know-how of crane applications with the latest technology. |
| Crane user interface | Interface with pre-designed locations for typical crane functions. The main part of this interface is carried out by a terminal strip, which has separated sections for signals with main, control and electronics voltage levels. |
| Brake control | Includes the brake contactor for disk brakes. |
| Electrical Braking | Includes a braking transistor and a braking resistor. |
| Control modes | Can be controlled by the electronic potentiometer control with 2-step or 3-step pushbuttons, the multistep control with 2-5-step controllers. the automation control using any control device with an 0-10V output (computer, radio, PLC) |
| Limit switch functions | Built-in slowdown (S11, S21) or stop limit switch (S12, S22) functions for both running directions. |
| Protections | Includes a motor thermal protection, which is based on motor temperature measurement by Klixon placed in motor windings. A great number of other protections included are shown in the technical data. |

2.3 Main components

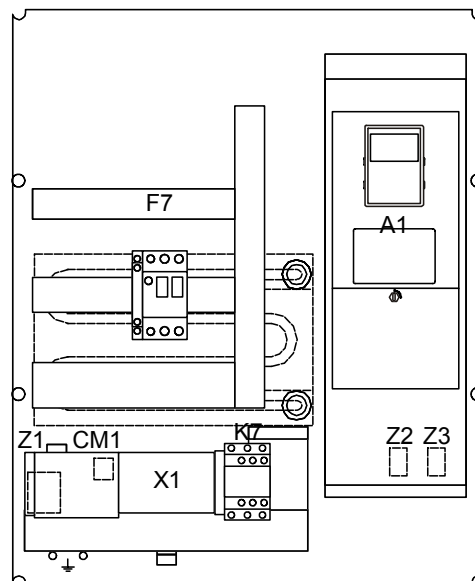
The main components are:

| | |
|------------|---|
| A1 | Inverter |
| F7 | Brake supply circuit breaker |
| K7 | Brake contactor |
| R1 | Braking resistor unit |
| Z1, Z2, Z3 | Ferrite rings (Depending on EMC level, optional) |
| CM1 | Filtering capacitors (Depending on EMC level, optional) |
| X1 | Terminals |

The most important external components are:

| | |
|--------------------|--|
| M1 | Traveling motor(s) |
| Y1 | Mechanical brake |
| B6 | Thermal sensor for motor protection |
| | Control devices (switches, pushbuttons etc.) |
| S11, S21, S12, S22 | Limit switches |

Example layout





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2.4 Functional description

Operation when power is switched on

- Stop limit switches S12 & S22 and slow down limit switches S11 & S21 are assumed to be normally closed, as well as the emergency stop button ES.
- The control voltage is supplied to X1:5 and X1:6. The main voltage is connected to inverter power supply and then inverter wakes up.
- If either of the direction signals S1 or S2 is on, the display shows F6 (fault code, see Chapter "Inverter fault codes") and driving can begin only after the direction signals have been off more than 0.3s.

Normal operation

- For the description of the speed reference setting see Chapter "Control methods". Travelling starts when switch S1 or S2 closes. Closing the contact ROD1 on A1 energizes K7, which opens the brake. Motor accelerates according to the acceleration ramp setting to the selected speed.
- When the switch S1 or S2 opens motor stops according to the deceleration ramp setting and the brake closes.
- R1 dissipates the regenerated energy during deceleration periods. The power supply to R1 is controlled by A1

Other features

- Thermistor relay function, which can be used as needed.
- When the stop limit switch S12 or S22 opens, K7 de-energizes and the mechanical brake stops the motion.

2.5 Factory code example (Factory: D2M)

| | | | | | | | |
|-----------------------------------|---|-------------------------------------|--------------------------|-------------------|----------------|----------------|-------------------------|
| D2M TR01 BT01 1-3 | 007 (ELE84) (ELE85) 4-6 | F (ELE84) (ELE85) 7 | V (ELE02) 8 | 10 9,10 | B 11 | 0 12 | N ELE97 13 |
|-----------------------------------|---|-------------------------------------|--------------------------|-------------------|----------------|----------------|-------------------------|

| Pos. | Code | Feature code | Feature | Available properties | | | |
|------|------------|--------------------|-----------------------|--|--------------------------|---|----------------------------------|
| 1-3 | D2M | TR01 BT01 | Device name | D2M | | TR01 Type of trolley travel control BT01 Type of bridge travel control | |
| 4-6 | 007 | (ELE84) (ELE85) | Power rating class | 002 – 022 | | ELE84 Trolley travel inverter power rating ELE85 Bridge travel inverter power rating | |
| 7 | F | (ELE84) (ELE85) | Supply voltage | F 380 – 500 VAC, 50/60 Hz | | Values are composed of two features, Power rating class and Supply voltage. e.g. 007F = ELE84/ELE85 value | |
| 8 | V | (ELE02) | Control voltage | Y 42VAC, 50/60 Hz P 48VAC, 50/60 Hz | <u>ELE02 value</u> 48 | T 115VAC, 50/60 Hz V 230VAC, 50/60 Hz | <u>ELE02 value</u> 115 230 |
| 9,10 | 10 | | Revision code | The latest revision may differ. | | | |
| 11 | B | | Braking resistor type | A External resistor, D2M 018 – 022 (002-004 as option) | | B Internal resistor, D2M 002 – 015 | |
| 12 | 0 | | Mounting | 0 Standard panel | | W Wall mounting, D2M002 (003-004 as option) | |
| 13 | N | ELE97 | EMC level | S Standard, without EMC filters (grounded network) N EMC, Second environment (grounded network) | | 0 IT network (non-grounded network) | |

2.6 Description of the control modes

There are three main control modes with 8 different choices:

| | | |
|---|----|--|
| 1 | EP | Electronic potentiometer function. • Stepless control using a 2-step controller. • EP3 stepless control using a 3-step controller. |
| 2 | MS | Multistep control (up to 5 steps) • Requires programmable digital inputs for speed reference steps |
| 3 | AU | Automation control for any control device with an output in the range of 0 – 10V • E.g. radio controls, process computers. |



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All control methods are available without any changes in the hardware or software.

The control mode of inverter is selected by parameter P1.1.11 Input set, which has eight alternative settings: MS2 (stop-limit), MS2/MS3 (slow-limit), EP2 (stop-limit), EP2 (slow-limit), EP3, MS4, MS5 and AU (automation control). (See Chapter 5: parameter descriptions.) The parameter assigns digital inputs S1, S2 and DID3-DID5. It is not possible to change the functions of the inputs separately. Digital inputs DID1 and DID2 are for direction commands, so DID1 = S1, DID2 = S2 in every case. Digital inputs (DID3-DID5) are automatically assigned according to the selected mode. In mode MS5, the MAX speed will be activated when DID4 is off and DID5 is still on. The state of inputs can be checked from parameter V2.3.

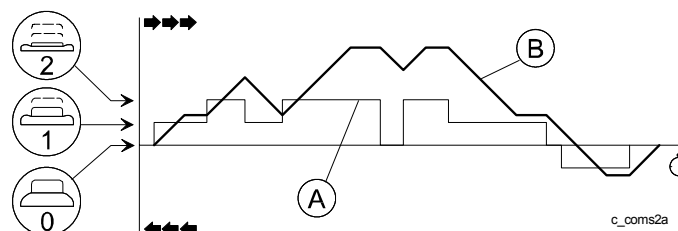
| Control Mode | | MS2 (stop-lim) | MS2 (slow-lim) | EP2 (stop-lim) | EP2 (slow-lim) | EP3 | MS4 | MS5 | AU (Ain1) |
|-------------------|----------|----------------|----------------|----------------|----------------|---------|-----|---------|-----------|
| Parameter P1.1.11 | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Signal | Terminal | | | | | | | | |
| S1 | X1:38 | S1 | S1 | S1 | S1 | S1 | S1 | S1 | S1 |
| S2 | X1:39 | S2 | S2 | S2 | S2 | S2 | S2 | S2 | S2 |
| DID3 | X1:40 | MAX | MAX | AP | AP | AP | MS2 | MS2 | S11/S21 |
| DID4 | X1:41 | S12 | S11/S21 | S12 | S11/S21 | HOLD | MS3 | MS3/MAX | S12 |
| DID5 | X1:42 | S22 | ES | S22 | ES | S11/S21 | MAX | MS4 | S22 |

| | | | |
|----------------|------------------------|-------------|------------------------|
| S1 | Drive command forward | S2 | Drive command reverse |
| AP | Acceleration command | HOLD | Hold speed command |
| S11 | Slowdown limit forward | S21 | Slowdown limit reverse |
| S12 | Stop-limit forward | S22 | Stop-limit reverse |
| S11/S21 | Common slowdown limit | MS2 | Multistep Frequency2 |
| MS3 | Multistep Frequency3 | MS4 | Multistep Frequency4 |
| MAX | Maximum frequency | ES | External stop |

Desired speed levels for multi-step control mode are selected with following parameters

| Speed | Parameter | Input |
|---------------------------------|-----------|-------|
| Speed 1 | P1.1.4 | S1/S2 |
| Speed 2 | P1.1.8 | MS 2 |
| Speed 3 (only available in MS4) | P1.1.9 | MS 3 |
| Speed 4 (only available in MS5) | P1.1.10 | MS 4 |
| Speed 5 | P1.1.5 | MAX |

2.6.1 MS2-control



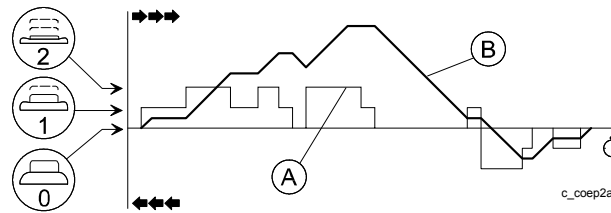
A. Pushbutton / controller position
B. Speed

- 0) "decelerate to zero"
- 1) step 1 "drive minimum speed"
- 2) step 2 "drive maximum speed"



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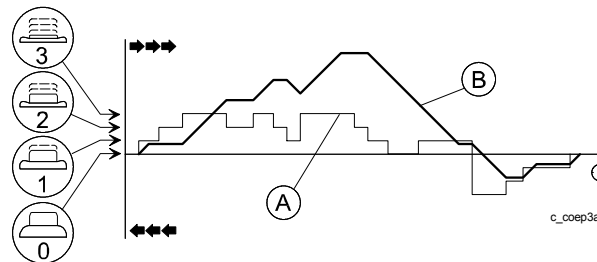
2.6.2 EP2-control



A. Pushbutton / controller position
 B. Speed

- 0) "decelerate to zero"
- 1) while starting "drive minimum speed"
while running "hold speed"
- 2) while running "accelerate"
while running at maximum speed "hold speed"

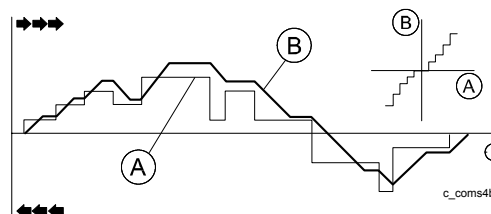
2.6.3 EP3-control



A. Pushbutton / controller position
 B. Speed

- 0) "decelerate to zero"
- 1) step 1 "drive minimum speed"
- 2) step 2 "hold speed"
- 3) step 3 while running "accelerate"
while running at maximum speed "hold speed"

2.6.4 MS4-control



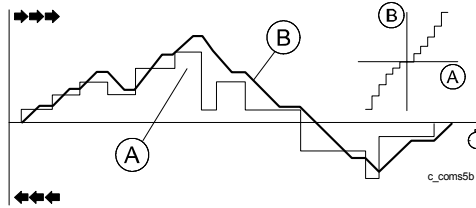
A. Controller position
 B. Speed

- 0) "decelerate to zero"
- 1) step 1 "drive minimum speed"
- 2) step 2 "drive speed2"
- 3) step 3 "drive speed3"
- 4) step 4 "drive maximum speed"



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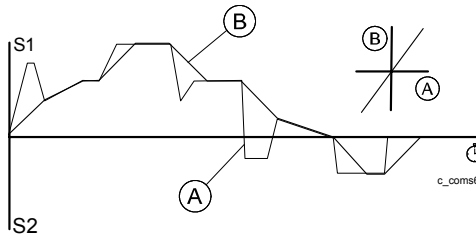
2.6.5 MS5-control



A. Controller position
 B. Speed

- 0) "decelerate to zero"
- 1) step 1 "drive minimum speed"
- 2) step 2 "drive speed2"
- 3) step 3 "drive speed3"
- 4) step 4 "drive speed4"
- 5) step 5 "drive maximum speed"

2.6.6 AU/PO-control



A. Reference
 B. Speed

AU control may be used with control device with an output in the range of 0 V – 10 V (for example radio or PLC).

PO control may be used with a controller with potentiometer.

The operation is as follows:

- Driving command S1 or S2 is given separately and means "drive minimum speed"
- The speed linearly follows the analog input signal.

2.7 Slowdown-limit operation

The slowdown function is available in MS2- (slow-lim), EP2- (slow-lim), EP3- and AU-control modes. It can reduce maximum frequency at the both ends of the crane runway. When the function is active, the reference slowdown frequency is set automatically by parameter P1.1.8 "Multistep freq2/Slowdown".

The action in slowdown-limit area depends on parameter P1.5.1 "Slowdown Mode" settings. The description on "Slowdown Mode" selections is shown as follows:

| Parameter value | Action |
|-------------------|---|
| 0 = Slow | When the limit switch circuit is opened, the maximum speed is limited in both directions until the limit switch circuit is closed. |
| 1 = Fast | When the limit switch circuit is opened during running the slowdown function is activated and the maximum speed is limited in the present running direction. If the limit switch circuit is open when power is turned on, the maximum speed is limited in both directions until the limit switch circuit is closed. |
| 2 = Fast power up | When the limit switch circuit is opened during running the slowdown function is activated and the maximum speed is limited in the present running direction. When power is turned off, the limit switch status is saved in EEPROM. When power is turned back on and limit switch circuit is open, driving is allowed the maximum speed in opposite direction. |



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2.8 Stop-limit operation

Stop-limit function is available in MS2- (stop-lim), EP2- (stop-lim), and AU-control modes. Normally these inputs (S12 and S22) are "high" (limit switch closed, voltage present in the input). When either of these signals goes "down" (no voltage in the input), the motion is stopped by switching the motor current off immediately and by opening the relay contact ROD1 (mechanical brake closes).

Restart may occur only after one second. Restart is only allowed to the direction opposite to the stop-limit switch circuit being off. If both of these inputs are off restart is not permitted. Restart may be initiated only by a run command changing from off to on (= before restart both run commands must be off after the one-second time has passed).

2.9 Mechanical brake control

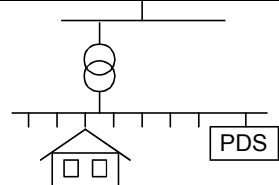
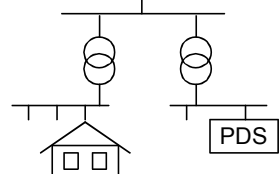
Inverter has a brake contactor to control electromechanical disk brake of the traveling motor. When there is no voltage present the brake is closed and also kept closed by spring force.

The brake is controlled so that during starting first the motor generates torque and after that the brake is opened. The same applies for stopping; while the brake is being closed, the motor still generates torque. During a direction change, the brake is kept open all the time. Inverter decelerates the motor to a stop according to the set deceleration time when the run command is switched off, so the brake is used only as a holding brake. This way brake wear is minimized. Only if a failure occurs or the emergency stop button is pushed, the brake closes immediately stopping the motor.

2.10 EMC

The abbreviated "EMC" stands for the Electromagnetic Compatibility. According to the European EMC directive "the apparatus shall be so constructed that:

- The electromagnetic disturbance it generates does not exceed a level allowing other apparatus to operate as intended
- The apparatus has an adequate level of intrinsic immunity of electromagnetic disturbance to enable it to operate as intended."

| | | |
|---------------------------|---|---|
| Declaration of conformity | With the declaration of conformity the manufacturer informs that device is manufactured to fulfill required EMC standards. | |
| CE-mark | The CE marking is a declaration by a manufacturer or importer located in the European Economic Area that a product complies with the safety and health requirements of the directive in question. The manufacturer demonstrates for the authorities that the product complies with the safety requirements within the EU. | |
| Environments | <ul style="list-style-type: none"> • Immunity and emission requirements are divided in two levels in the product standard according to the environments. | |
| | First environment means environment that includes domestic premises and also establishments directly connected to a low-voltage power supply network. |  |
| | Second environment means environment that includes all establishments other than those directly connected a low-voltage power supply network |  |



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2.10.1 EMC levels

Three kinds of EMC levels are available, they are S, N and 0 level.

- S-level: No manufacturer's EMC solution is adopted and products will be used in other market areas than European Union (EU) when local power supply system is the grounded network.
- N-level: Manufacturer's EMC solution is adopted to fit for Second Environment and products will be used in EU when local power supply system is the grounded network.
- 0-level: No manufacturer's EMC solution is adopted, products can be used in either EU or other market areas when local power supply system is the non-grounded network.

2.10.2 Fulfilled EMC-standards

| | |
|------------------|--|
| Immunity | All products fulfil the immunity requirements defined in the EN 61800-3 Amendment 11 (2000) for the second environment. |
| Emissions | N level products fulfil the emission requirements (lower than specification) of the EN 61800-3 A11 2000 for the second environment. 0 level products fulfil the emission requirements (they might exceed the limit of N level products) of the EN 61800-3 A11 2000 for the second environment |



The involved products are designed for Second Environment (Industrial Environment) only. The disturbances emitting from the basic products are not filtered to the required level of residential, commercial and light industrial (e.g. offices, gasoline station, retailer shops etc.) environment (First Environment). In this sense, these products should not be used in First environments. If you still want to use them in First environments, additional requirements are needed, please contact product supplier.



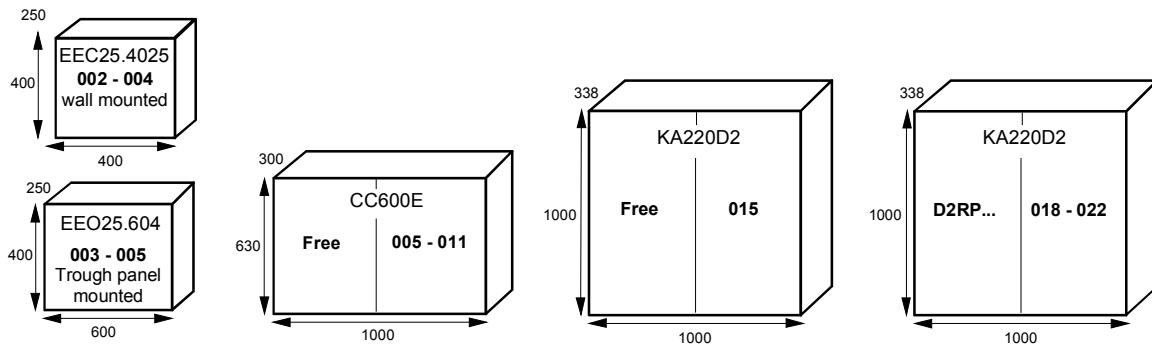
EMC filters in N level products might cause disturbances on fault (leakage) current relay

3 INSTALLATION

3.1 Cubicles

| Wall mounting | | | DMHR01F90, External Braking resistor unit (mm) |
|---------------|------------------|-------------------|--|
| | Standard cubicle | Cubicle size (mm) | |
| 002F | - | 400 x 400 | 325 x 170 x 147 (optional) |
| 003F – 004F | EEC25.4025 | 400 x 400 | 325 x 170 x 147 |

| Through panel mounting | | | D2RP03F21R2S0-6, External Braking resistor unit (mm) |
|------------------------|------------------|-------------------|--|
| | Standard cubicle | Cubicle size (mm) | |
| 003F – 004F | EEO25.604 | 400 x 600 | - |
| 005F – 011F | ½ CC600E | 600 x 1000 | - |
| 015F | ½ KA220D2 | 1000 x 1000 | - |
| 018F – 022F | KA220D2 | 1000 x 1000 | Included |



3.2 Power cabling

3.2.1 Shielded motor cable

In crane application inverter fulfills EN61800-3/A11 - second environment radiated emission requirements without shielded motor cable.

In the second environment, shielded motor cable is recommended to use in fixed installations, especially in buildings. However motor cables in crane and festoon power supplies are normally not shielded due to the practical reasons.

3.2.2 Double collectors

If the power is supplied to the crane via conductor rails, double collectors are needed. This ensures a reliable contact with the rail in all circumstances. Short interruptions and sparks between the conductor rail and the collector may cause nuisance tripping or other undesired operations and in worst case even permanent damage to components.

3.2.3 Cable selection

Cabling for inverter can be done using normal crane cables. All the cables must be dimensioned according to local regulations. Ambient temperature, cabling method (size of bunches etc.) and allowable current for the cable in use must be taken into consideration. If there are no other regulations, following values can be used (three phase 400V supply).



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The table below is based on ED ≤ 60% (60% duty cycle) and an ambient temperature of +40°C (104°F). A higher ambient temperature may require increased cable sizes. The input current does not exceed the continuous current (I_{CONT}) of inverter, so it is selected to be the dimensioning current. If the actual load current is below inverter continuous current, then the fuses and the supply cable may be dimensioned according to the load current.

| Power class | | | 002F | 003F | 004F | 005F | 007F | 011F | 015F | 018F | 022F |
|------------------------|-------------------|-----------------|------|------|------|------|------|------|------|------|------|
| Continuous current | I _{CONT} | A | 5.0 | 8 | 10 | 13 | 18 | 24 | 32 | 42 | 48 |
| Fuse | | A | 10 | 10 | 10 | 16 | 20 | 25 | 35 | 50 | 50 |
| Max motor cable length | | m | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| | | Ft | 160 | 160 | 160 | 160 | 160 | 160 | 160 | 160 | 160 |
| Motor cable | 40°C | mm ² | 1.5 | 2.5 | 2.5 | 2.5 | 4 | 6 | 10 | 10 | 10 |
| | 104°F | AWG | 14 | 14 | 14 | 12 | 10 | 10 | 8 | 8 | 6 |
| Braking resistor cable | 40°C | mm ² | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 4 | 4 |
| | 104°F | AWG | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 12 | 12 |

3.2.4 Cable protection

To protect the supply cables against short circuit there must be fuses or motor circuit breakers (MCCBs) installed at the mains end of the supply cable. Dimensioning of the fuses or MCCBs depends on the cable used and on the type of primary fuses or MCCBs. If there are no other regulations, the values given in this section can be used to dimension fuses (three phase 400V power supply).

The overload protection of inverter protects both the supply and the motor cables. The fuses of the supply provide the short circuit protection.

3.2.5 Cable length

The maximum motor cable lengths in the preceding table are based on 150% of inverter rated current (=current during acceleration) and a 2.5 % voltage drop in the cable. For longer cables, the required conductor cross sectional area A (mm²) is given by formula

$$A = 2.43 \times \frac{l \times 1.5 \times I_F}{p \times U}$$

where l is the cable length (m)
 I_F is the motor current (A) at shaft power P_F
 p is the allowed voltage drop in %
 U is the nominal motor voltage

3.2.6 Du/dt filters

Du/dt filters should be used also in IT-network.

3.2.6.1 002 – 004

Du/dt filter at motor supply is needed if

- Motors are not made for inverter use
- Inverter is not mounted on the crane
- Number of motors is greater than 2
- Total motor cable length is over 100m (330ft)



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3.2.6.2 005 – 022

Du/dt filter at motor supply is needed if

- Motors are not made for inverter use
- Inverter is not mounted on the crane
- Number of motors is greater than 4
- Total motor cable length is over 200m (660ft)

| Power class | Platthaus du/dt filter | Length (mm) | Width (mm) | Height (mm) | Weight (kg) | ID |
|-------------|------------------------|-------------|------------|-------------|-------------|----------|
| 002 – 003 | ULC-910-920 | 100 | 110 | 180 | 1.2 | 52306553 |
| 004 – 005 | ULC-914-931 | 125 | 110 | 200 | 3 | 52306554 |
| 007 – 018 | ULC-918-951 | 155 | 125 | 225 | 7 | 52306555 |
| 022 | ULC-923-927 | 190 | 135 | 260 | 12 | 52306556 |

3.3 EMC compatible grounding

3.3.1 Construction connections

All metal construction parts of the cubicle must be electrically connected to each other using largest possible surface area. Paint to paint connection must not be used.

3.3.2 Cable connections

Control cables and power cables should be separated and routed separately for eliminating noise coupling. The distance between braking resistor cables and the other cables should be kept as large as possible. The distance between the resistor cables should be kept as short as possible to prevent the antenna behavior. Cable lengths should be kept as short as possible to minimize coupling capacitances and inductances.



Du/dt filter should be installed as close as possible to inverter.



All control cables must be placed as far as possible from the motor and braking resistor cables.



Please take care of the necessary cooling/heating to ensure that the ambient temperature of inverter is within -10°C to $+50^{\circ}\text{C}$ if it is installed in a harsh environment.



If EMC / Noise problems occur during your installation, please follow the EMC plan or contact the manufacturer.

4 COMPONENTS

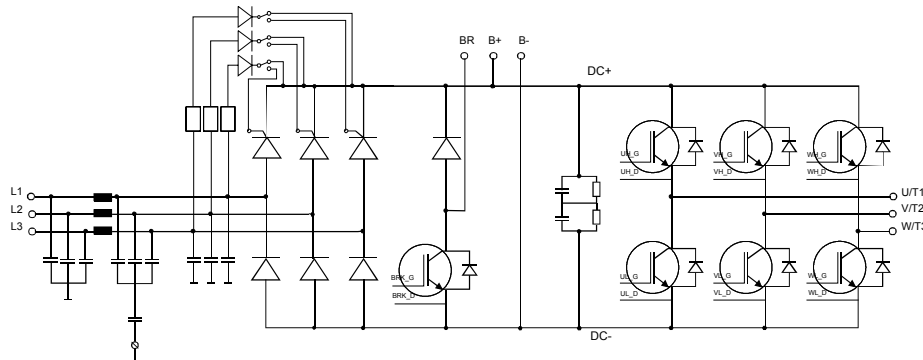
4.1 Inverter

Inverter (D2S) includes a Power supply unit (PSS) and a Control unit (CSS), which are separate parts. PSS includes supply, brake resistor and motor connections. IGBTs are located within the PSS. Microprocessors and Application Special Integral Circuit (ASIC) Chip are located within the CSS. Same CSS can be used for all models of the D2S.

| D2S (F-series) | I_{in} (A) | I_{max} at 1min IA) | Weight kg | Weight lbs |
|----------------|--------------|-----------------------|-----------|------------|
| D2S002NF1e00 | 5.0 | 7.6 | 1.9 | 4 |
| D2S003NF1e00 | 8 | 12 | 5 | 11 |
| D2S004NF1e00 | 10 | 15 | 5 | 11 |
| D2S005NF1e00 | 13 | 20 | 8.1 | 18 |
| D2S007NF1e00 | 18 | 27 | 8.1 | 18 |
| D2S011NF1e00 | 24 | 36 | 8.1 | 18 |
| D2S015NF1e00 | 32 | 48 | 18.5 | 41 |
| D2S018NF1e00 | 42 | 63 | 18.5 | 41 |
| D2S022NF1e00 | 48 | 72 | 18.5 | 41 |

e defines EMC level (0 = EMC level 0, N = EMC level S/N)

The main circuit diagram of D2S 007 – D2S 015



4.1.1 Power supply unit (PSS)

Power supply unit (PSS) includes the main circuit components. PSS has connectors for supply cables, motor cables and braking resistor cables. PSS also includes a connector for CSS-connection.

| Main supply voltage terminals | |
|--------------------------------|---|
| L1 | Mains L1 |
| L2 | Mains L2 |
| L3 | Mains L3 |
| PE | Protective earth (Ground) |
| DC-bus terminals | |
| B- | DC-bus negative (003-022) |
| B+ | DC-bus positive (003-022) |
| R- | Brake resistor negative (003-022) |
| BR+ | DC-bus positive / Brake resistor positive (002) |
| BR- | Brake resistor negative (002) |
| Motor output voltage terminals | |
| U/T1 | Motor U/T1 |
| V/T2 | Motor V/T2 |
| W/T3 | Motor W/T3 |

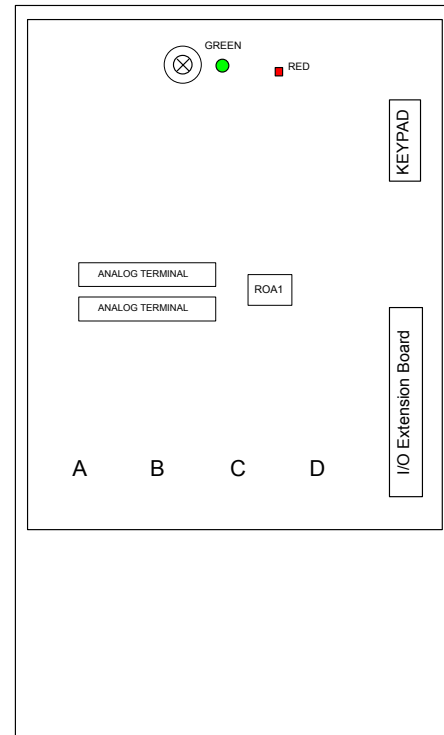


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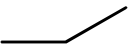
4.1.2 Control unit (CSS)

Control unit (CSS) includes a control board with five board slots for option boards and a control keypad for parameter adjustments. Inverter uses only one of the existing slots and is used to connect I/O extension board. The CSS is connected to PSS through a connector.

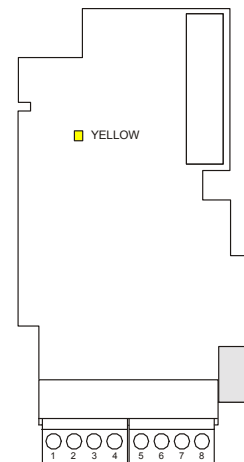
| Green | Red | Status |
|----------|----------|------------------------------------|
| ON | OFF | Everything is OK. |
| blinking | ON | Fault |
| blinking | blinking | In process of software downloading |



4.1.3 I/O Extension board

| NXOPTB9 / I/O Extension board ID: 52305691 | | |
|--|-------------|--|
| Terminal | Signal name | Description |
| 1 | DID1 | 42-240Vac 50/60Hz |
| 2 | DID2 | 42-240Vac 50/60Hz |
| 3 | DID3 | 42-240Vac 50/60Hz |
| 4 | DID4 | 42-240Vac 50/60Hz |
| 5 | DID5 | 42-240Vac 50/60Hz |
| 6 | COM | Common for DID1-DID5 |
| 7 | ROD1 |  Relay output, 250V 8A, normal open For brake contactor control |
| 8 | ROD1 | |

| LED | Blinking | Status |
|--------|----------|---|
| Yellow | 0.25Hz | OK |
| Yellow | 4Hz | Board internal fault or communication fault with control unit |



4.2 Control voltage transformer

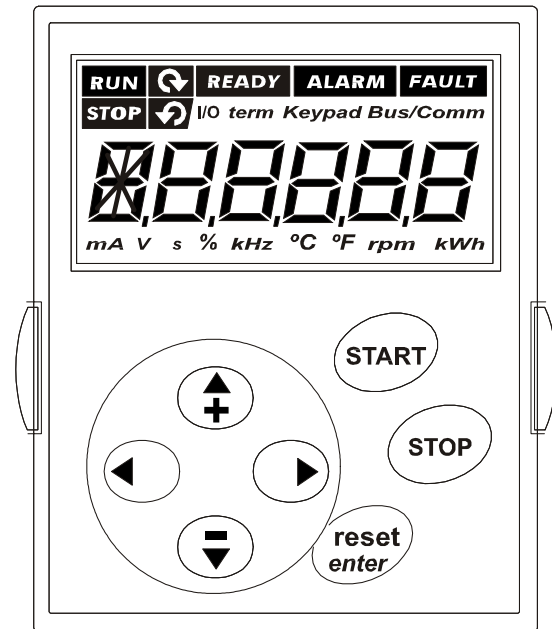
Power of control voltage transformer has to be $n * 50VA + 50VA$ (min. 250VA), n = number of inverters. This power does not have to be added to otherwise needed transformer power.

5 PARAMETER ADJUSTMENTS

5.1 The display panel

The display panel is used for:

- Displaying the drive identification, electrical values, operating or fault parameters
- *Altering the parameter settings*



Meaning of the displays:

Drive status indications:

| | |
|--------------|--|
| RUN | Motor is running, blinks when ramping down. |
| ↺ ↻ ↻ | Direction of motor rotation. |
| STOP | Motor is not running. |
| READY | Power is on. In case of a fault, the symbol will not light up. |
| ALARM | Drive is running outside of certain limit. |
| FAULT | Fault is active |

Control place indications:

| | |
|-----------------|---|
| I/O term | I/O-terminals are the selected control place |
| Keypad | Keypad is the selected control place (not used) |
| Bus/Comm | Control through Profibus is selected (not used) |

Button description









| | |
|--------------------|---|
| ↵ + | Browse the main menu and the pages of submenus Edit values |
| ▶ ◀ | Move in menu Move cursor Enter and exit edit mode |
| START | Start button |
| STOP | Stop button |
| reset enter | Active faults reset / Fault history reset /Confirmation of selections |

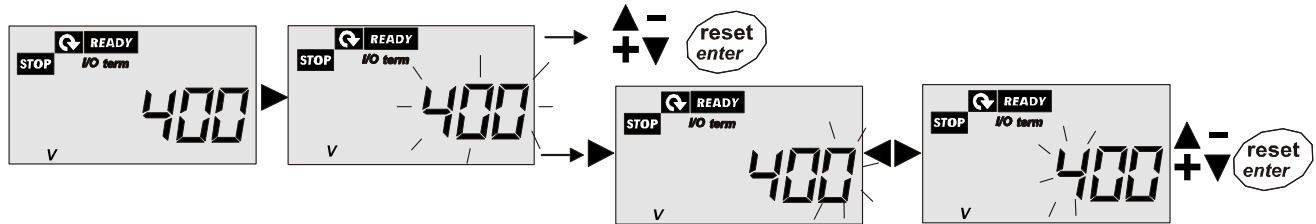
5.2 Navigation on the control keypad

5.2.1 Editing numerical settings



WARNING! Changing parameter settings during running may cause a hazardous situation. Parameter settings must not be changed during running.

- Pushing  button takes you into the edit mode. As an indication, the parameter value starts to blink.
- Two different methods are available to change values.
One is to set with   buttons till your desired value,
Another is to select desired digit and edit it. First push , the digit before decimal point will blink, then use   buttons to select desired digit, set value with   buttons.
- Accept and exit with “reset/enter” button.



5.3 Storing and restoring parameters

5.3.1 User parameters

- File “User parameters” is stored in inverter’s control unit.
- User parameters should be saved after final set up.
- The whole customized parameter set can be stored with parameter P3.3.1 by option 1(=Store user parameters)
 - Select Option number 1, then press “Enter”
- User parameters can be restored with parameter P3.3.1 by option 2 (=Load user parameters).
- Select Option number 2, then press “Enter”
- After restoring always check the motor parameters.

5.3.2 Factory parameters

- File “Factory parameters” is stored in inverter’s control unit.
- Factory parameters are saved at the factory according to the order and they should not be changed, the values are the same as those in parameter list delivered with inverter.
- Factory parameters can be restored with parameter P3.3.1 by option 4 (=Load factory parameters).
- Select Option number 4, then press “Enter”
- After restoring always check the motor parameters.

5.4 Motor parameterization

There are two different ways to set up motor parameters.

- The motor can be selected from the motor list of parameter P1.2.2. (default values can be checked from *Chapter "Factory parameters"*). All motor parameters of these motors are stored in the inverter memory. If motor selection parameter is changed to the value 1 “Free Travel”, these parameters can be changed afterwards.
- Parameters may be set up manually or by Autotuning. Autotuning sets U/f curve, torque boost and current limit.



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5.4.1 Voltage at low frequencies (U/f- curve)

Following parameters need to be set for U/f setting. For listed motors, values of these parameters are stored into the inverter memory, but they can also be set manually or by Autotuning. The manual setting procedure is as follows:

5.4.1.1 Starting values

| | | | | Value |
|-----------|---------------|---|--|-------|
| U_N | P1.2.1 | Motor nominal voltage | From motor nameplate | V |
| f_N | P1.2.4.1 | Motor nominal frequency | From motor nameplate | Hz |
| I_N | P1.2.4.2 | Motor nominal current | From motor nameplate | A |
| R_S | Not parameter | Stator resistance of motors + cable resistance | Resistance between phases. Measured on disconnected motor cable ends at terminal X1. | Ohm |
| I_0 | P1.2.4.3 | Flux current | From motor nameplate (if not available, set to value $0,5 \cdot I_N$) | A |
| U_{f0} | P1.2.5.1 | Zero frequency voltage % of nominal voltage (voltage at 0Hz) | $\frac{100 * R_S * I_0}{U_N}$ | % |
| U_{mid} | P1.2.5.2 | Midpoint voltage % of nominal voltage (voltage at f_{mid}) | $1,41 * U_{f0}$ | % |
| f_{mid} | P1.2.5.3 | Midpoint frequency | $\frac{U_{f0} * f_N}{100}$ | Hz |



If several motors are connected in parallel, the correct value of R_S is the resistance of one motor divided by the number of motors. The correct value of I_N and I_0 are the value of one motor multiplied by the number of motors

5.4.1.2 Midpoint voltage adjustment

- Check that there is no load on the crane.
- Set minimum speed for both directions (P1.1.4) to value f_{mid} .
- Drive at maximum speed and check the motor current from parameter V2.5.
- Drive at minimum speed. Motor current should be approximately average of measured maximum speed current and the I_N .
- Adjust value of parameter U_{mid} (P1.2.5.2) until current at minimum speed ($= f_{mid}$) is within desired range.

5.4.1.3 Zero frequency voltage adjustment

- Set minimum speed for both directions (P1.1.4) to value $0.5 * f_{mid}$.
- Drive at minimum speed. Motor current should be approximately average of measured maximum speed current and the I_N .
- Adjust value of parameter U_{f0} (P1.2.5.1) till current at minimum speed ($= 0.5 * f_{mid}$) is within desired range

5.4.1.4 Test run

- Set minimum speed for both directions (P1.1.4) to desired minimum speed.
- Drive at minimum speed with nominal load to both directions.
- If motor is not driving at minimum speed, increase values of parameters U_{f0} and U_{mid} , then continue from Midpoint voltage adjustment.



If the main girder is new, it might be necessary to drive trolley several times with no load from end to end, before beginning of u/f-curve tuning.



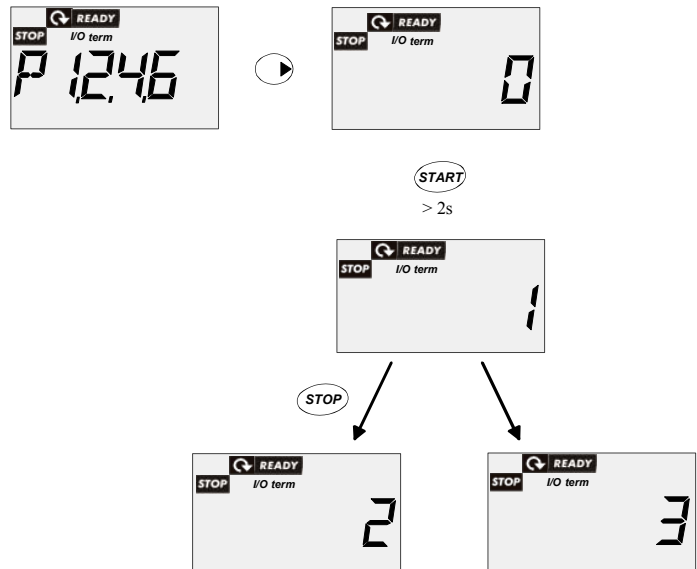
Check minimum speed from the crane calculations. Minimum speed is not allowed to be under

$$\text{nominal slip } S_n = \frac{(\text{synchronspeed} - \text{nom.speed}) * \text{nom.frequency}}{\text{synchronspeed}}$$

5.4.2 Autotuning

Before Autotuning,

- Check that there is no load on the crane.
- Set P1.1.1. "Password" = 2156
- Set P1.2.2 "Motor selection" = 1 "Free Travel"
- Set Motor nameplate values P1.2.1, P1.2.4.1- P1.2.4.3
- (if value of P1.2.4.3 "Nom Flux Curr" is not available, set to value 0.00. Parameter P1.2.4.3 will be used if it's value differs from 0.00. Otherwise P1.2.4.5 "Motor Cos Phi" value will be used.)
- Set Motor nameplate values P1.2.4.5 "Motor Cos Phi" as it will be used when value of P1.2.4.3 is 0.00.
- Check motor connections



- Go to parameter P1.2.4.6
- Push Start over 2 seconds to start Autotuning
- Autotuning can be terminated pushing Stop-button.
- Autotuning values will be accepted automatically if Autotuning did not fail or was not terminated.
- When parameter P1.2.4.6 has value "3", Autotuning has been done successfully.
- If parameter P1.2.4.6. has value "2", Autotuning has failed or has been stopped. Check motor parameters and motor connection.

The explanations on Autotuning parameter P1.2.4.6 is as follows:

| Parameter number | Parameter name | Description |
|------------------|----------------|---------------------------------------|
| P1.2.4.6 | Autotuning | 0 Autotuning has not been done |
| | | 1 Autotuning in progress |
| | | 2 Autotuning has been failed |
| | | 3 Autotuning values has been accepted |
| | | 4 Autotuning values has been modified |

Autotuning will set open loop U/f-curve, RsVoltageDrop, torque boost and current limit parameters automatically.

| Parameter number | Parameter name |
|------------------|--------------------|
| P1.2.5.1 | Zero Freq Volt |
| P1.2.5.2 | U/f Mid Volt |
| P1.2.5.3 | U/f Mid Freq |
| P1.2.5.4 | Torque boost => on |
| P1.2.5.7 | Rs Voltage Drop |
| P1.2.4.4 | Current Limit |



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6 PARAMETER DESCRIPTIONS

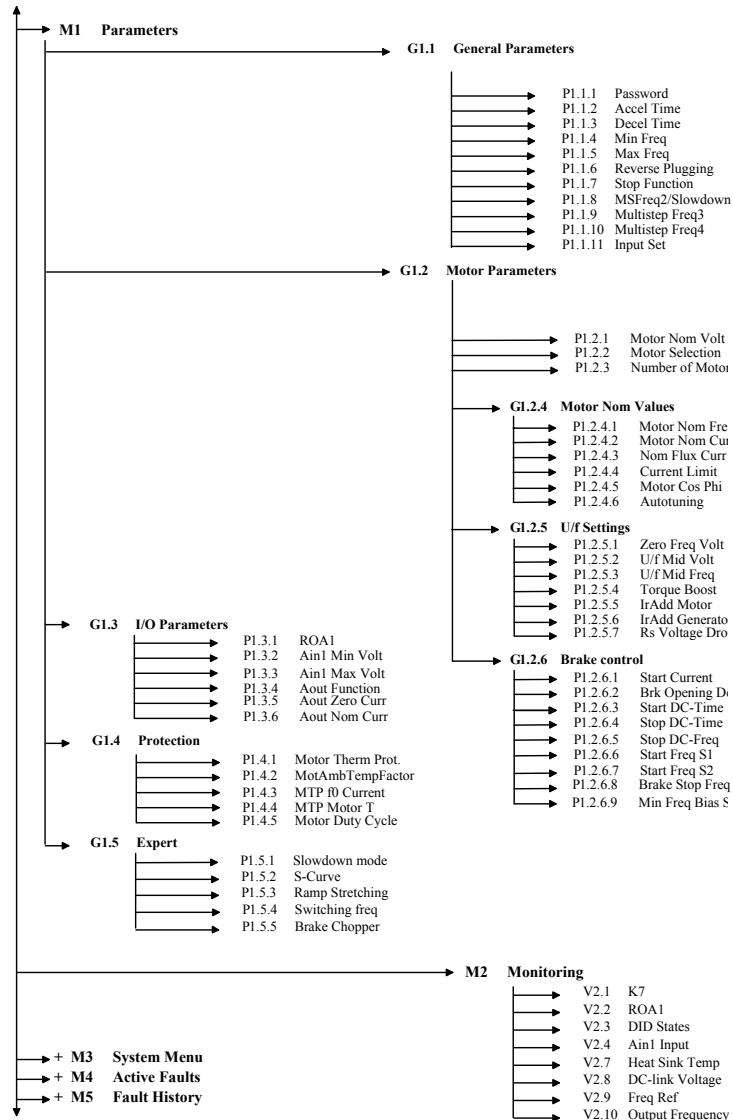
This manual describes the parameters software version D2S1V051. Underneath the control panel there is sticker for software version.

6.1 General Description

Parameters are assorted to Groups. All Groups are not always listed in control panel. Groups are shown in the control panel according to password level and selected functions. This feature makes the viewable parameter menu simple and only needed parameters are shown.

Letter front of the code number describes variable type

| | | |
|----------|---|----------------------|
| P | = | Parameter |
| G | = | Group |
| V | = | Value |
| M | = | Menu |
| S | = | System |
| F | = | Active Fault |
| H | = | Fault History |



6.2 Parameter descriptions

| P1 Parameters | | | | | |
|--------------------------|-------------------|-----|------|------|--|
| G 1.1 General Parameters | | | | | |
| Code | Name | Min | Max | Unit | Description |
| P1.1.1 | Password | 0 | 9999 | | The password 2156 makes group G1.3 visible |
| P1.1.2 | Acceleration Time | 0.0 | 20.0 | s | Time it will take to accelerate from zero to the set maximum frequency |
| P1.1.3 | Deceleration Time | 0.0 | 20.0 | s | Time it will take to decelerate from max frequency to zero. |



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| P1.1.4 | Minimum Freq | 0.00 | Max freq | Hz | The set minimum operating frequency. |
|--|-------------------------|----------|----------|------|---|
| P1.1.5 | Maximum Freq | Min freq | 120.00 | Hz | The maximum frequency may not be higher than the motor nominal frequency for listed motors. |
| P1.1.6 | Reverse Plugging | 50 | 100 | % | See <i>Chapter "Reverse plugging"</i> |
| P1.1.7 | Stop Function | 0 | 1 | | Stopping mode selection 0 = Brake 1 = Ramping, default Ramping: When the drive command is switched off the motion is stopped according to the set deceleration ramp. Brake: When the drive command is switched off the motor current is cut off, then the motion is stopped by the mechanical brake. |
| P1.1.8 | MSFreq2/Slowdown | 0 | 100 | Hz | Slowdown frequency and Multistep frequency2 |
| P1.1.9 | Multistep Freq 3 | 0 | 100 | Hz | 3 rd preset speed. |
| P1.1.10 | Multistep Freq 4 | 0 | 100 | Hz | 4 th preset speed. |
| P1.1.11 | Input set | 0 | 7 | | Control mode selection, see <i>Chapter "control methods"</i> 0 = MS2 (stop-limit) 1 = MS2/MS3 (slow-limit) 2 = EP2 (stop-limit) 3 = EP2 (slow-limit) 4 = EP3 5 = MS4 6 = MS5 7 = AU (Ain) |
| G1.2 Motor Parameters | | | | | |
| Code | Name | Min | Max | Unit | Description |
| P1.2.1 | Motor Nominal Voltage | 200 | 500 | V | Nominal motor voltage Un from motor nameplate. |
| P1.2.2 | Motor Selection | 0 | 9 | | 0 = Not Used 1 = Free Travel 2 = MF06MA100 3 = MF06MA200 4 = MF06LA100 5 = MF06LA200 (MF06LA200, 0.45kW/400V; 0.55kW/460V) 6 = MF06LA20P (MF06LA200, 0.65kW/400V; 0.75kW/460V) 7 = Not Used 8 = Not Used 9 = Free Hoist Note1: when one of listed motors is selected, Parameters group G1.2.4, G1.2.5 and G1.2.6 are not viewable. Parameters group G1.2.4, G1.2.5 can be viewed after P1.2.2 is set back to 1 "free travel" |
| P1.2.3 | Number of Motors | 0 | 10 | pcs | The parameter is not active if value 0,1 or 9 in P1.2.2 is selected |
| G1.2.4 Motor Nominal Values, see note1 | | | | | |
| Code | Name | Min | Max | Unit | Description |
| P1.2.4.1 | Motor Nominal Frequency | 0.00 | 120.00 | Hz | Nominal motor frequency (fn) from motor nameplate |
| P1.2.4.2 | Motor Nominal current | 0.0 | | A | Disc brake motors: Number of motors * In (Motor nominal current) Compact brake motors: Number of motors * In or Number of motors * 2,3A, if In<2,3A DC-current during starting = Motor Nominal current P1.2.4.2. * Start Current P1.2.6.1 DC-current during stoping = Motor Nominal current P1.2.4.2. |



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| P1.2.4.3 | Motor Nominal Flux Current | 0.0 | | A | Motor nominal flux current (I _o), same as no-load current or magnetizing current from motor nameplate. In multimotor drives nominal flux currents must be summed up. |
|---------------------------------|----------------------------|------|----------|------|--|
| P1.2.4.4 | Current Limit | 0.0 | | A | Defines the maximum motor current from the inverter. If the output current exceeds the value set in parameter P1.2.4.4 the output frequency is lowered until the current drops below the current limit. Typical value is 1.5 times motor(s) nominal (1,5xI _N). In multimotor drives nominal currents must be summed up. Must not be set over inverters max 1min. current. |
| P1.2.4.5 | Motor Cos Phi | 0.00 | 1.00 | | From motor nameplate (Power factor) |
| P1.2.4.6 | Autotuning | 0 | 4 | | See <i>Chapter "Autotuning"</i> 0 = Not Done 1 = Tuning 2 = Failed 3 = Done 4 = Modified |
| G1.2.5 U/f Settings, see note1 | | | | | |
| Code | Name | Min | Max | Unit | Description |
| P1.2.5.1 | Zero Frequency Voltage | 0.00 | 40.00 | % | Output voltage at zero frequency, % of motor nominal voltage. |
| P1.2.5.2 | U/f Middle point Voltage | 0.00 | 100.00 | % | Voltage in the selected middle point frequency, % of motor nominal voltage. |
| P1.2.5.3 | U/f Middle point Frequency | 0.00 | 120.00 | Hz | Middle point frequency. |
| P1.2.5.4 | Torque Boost | 0 | 1 | | Torque maximization 0 = Off 1 = On Torque boost is adjustable with parameters P1.2.5.5 "IrAdd Motor" and P1.2.5.6 "IrAdd Generator" when "Free Travel" or "Free Hoist" is selected with parameter P1.2.2 "Motor Selection" |
| P1.2.5.5 | IrAdd Motor | 0 | 100 | | With small speeds and heavy load the drive may not have enough voltage to produce sufficient torque. Raising the value of parameter increases the voltage. Default value is 30% in travelling and 100% in hoisting. |
| P1.2.5.6 | IrAdd Generator | 0 | 100 | | If motor voltage at generator area is too high, reducing value of parameter decreases the voltage. Default value is 50% in travelling and 0% in hoisting. |
| P1.2.5.7 | Rs Voltage Drop | 0 | 512 | | Relative value of motor stator impedance voltage drop. Value of this parameter is calculated by formula given below. <u>Motor Nom Flux current x Measured motor resistance (phase to phase) x 2217</u> Motor nominal voltage |
| G1.2.6 Brake Control, see note2 | | | | | |
| Code | Name | Min | Max | Unit | Description |
| P1.2.6.1 | Start DC-Factor | 0 | 200 | % | To adjust DC-current during starting. See P1.2.4.2 Travelling with disc brake motors 80%. Hoisting 100%. |
| P1.2.6.2 | Brake Opening Delay | 0.00 | 10.00 | s | Defines the opening delay of mechanical brake. "Start Freq S1" or "Start Freq S2" is commanded during "Brk Opening Del". After delay, output frequency increases according to the acceleration parameters. Default 0.05s |
| P1.2.6.3 | Start DC-Time | 0.00 | 5.00 | s | Defines duration of the "Start Current" |
| P1.2.6.4 | Stop DC-Time | 0.00 | 5.00 | s | Defines the function and the duration of the DC-braking time when stopping the motor. If "Stop DC-Time" = 0 the DC-braking is not used. |
| P1.2.6.5 | Stop DC-Frequency | 0.00 | 250.00 | Hz | Defines the DC-braking starting frequency |
| P1.2.6.6 | Start Frequency S1 | 0.0 | 100.0 | % | Defines the output frequency during brake opening delay in the S1 direction. |
| P1.2.6.7 | Start Frequency S2 | 0.0 | 100.0 | % | Defines the output frequency during brake opening delay in the S2 direction. |
| P1.2.6.8 | Brake Stop Frequency | 0.00 | Max Freq | Hz | Defines the output frequency when the relay output ROD1 for brake control opens during stopping |
| P1.2.6.9 | Minimum Frequency Bias S2 | 0.00 | Min Freq | Hz | Helps to define the Minimum frequency in down direction for hoisting. Minimum frequency in down direction is "Min Frequency" - "Minimum Frequency Bias S2". |



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| G1.3 I/O Parameters | | | | | |
|---------------------|----------------------|----------------|---------------|------|---|
| Code | Name | Min | Max | Unit | Description |
| P1.3.1 | ROA1 | 0 | 12 | | State of relay output ROA1 (See <i>Chapter "Relay output"</i>) 0 = Not Used 1 = Fault 2 = External Brake Control 3 = Run, current is fed to the motor, default 4 = Drive is ready to operate 5 = Drive is NOT ready to operate 6 = Fan. DC-link voltage is above braking chopper operating value –70V. Relay is closed minimum 300s. 7 = Emergency Stop, relay is activated in case of faults F1 Overcurrent, F2 Overvoltage, F3 Earth Fault. Relay is deactivated when the power is switched off. 8 = Reverse Plugging. Direction request is different than direction of actual frequency. 9 = At Speed. The Drive has reached the speed reference request. 10 = S2 Active. Motor actual speed direction is S2. 11 = Temp1. Relay is activated when temperature is 20°C (68F) or below. Relay is inactivated when temperature is 23°C (73F) or above. 12 = Temp2. Relay is activated when temperature is 40°C (104F) or above. Relay is inactivated when temperature is 37°C (98F) or below. |
| P1.3.2 | Ain1 Minimum Voltage | 0.000 | 10.000 | V | Minimum value of analog input Ain1 for AU-control |
| P1.3.3 | Ain1 Maximum Voltage | 0.000 | 10.000 | V | Maximum value of analog input Ain1 for AU-control |
| P1.3.4 | Aout Function | 0 | 5 | | 0 = Not Used 1 = Motor Freq (100%*Normal Motor Frequency) 2 = Motor Curr (100%*Normal Motor Current) 3 = Motor Volt (100%*Normal Motor Voltage) 4 = DC-link Volt (1000V) 5 = MotorFreqABS (Absolute value of Motor Frequency) |
| P1.3.5 | Aout Zero Current | 0.00 | Aout Nom Curr | mA | |
| P1.3.6 | Aout Nominal Current | Aout Zero Curr | 100.00 | mA | |
| G1.4 Not used | | | | | |
| Code | Name | Min | Max | Unit | Description |
| P1.4.1 | | | | | 0 = Default value 1 = must not be used 2 = must not be used |
| P1.4.2 | | | | | Not used |
| P1.4.3 | | | | | Not used |
| P1.4.4 | | | | | Not used |
| P1.4.5 | | | | | Not used |
| G1.5 Expert | | | | | |
| Code | Name | Min | Max | Unit | Description |
| P1.5.1 | Slowdown Mode | 0 | 2 | | 0 = Slow 1 = Fast, default 2 = Fast Power Up (See <i>Chapter "Slowdown-limit operation"</i>) |
| P1.5.2 | S-Curve | 0.00 | 0.50 | s | The start and end of the acceleration and end of deceleration ramp can be smoothed with this parameter. Setting value 0.00-0.50 seconds for this parameter produces an S-shaped acceleration/deceleration. |
| P1.5.3 | Ramp Stretching | 0.00 | 50.0 | | See <i>Chapter "Ramp Stretching"</i> . Not used in hoisting |
| P1.5.4 | Switching Frequency | | | | Must not be changed from factory setting |
| P1.5.5 | Brake Chopper | | | | 1, default Must not be changed |



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| M2 Monitoring | | | | | |
|--------------------------|------------------------------|--------|----------|------|---|
| Code | Name | Min | Max | Unit | Description |
| V2.1 | K7 | 0 | 1 | | State of relay output ROD1, which controls brake contactor |
| V2.2 | ROA1 | 0 | 1 | | State of relay output ROA1 |
| V2.3 | DID states | .00000 | .11111 | | State of digital input DID1-DID5, see note |
| V2.4 | Ain1 Input | 0.00 | 10.00 | V | Value of analog input Ain1 |
| V2.5 | Motor Current | | | A | Measured motor current |
| V2.6 | Motor Voltage | | | V | Calculated motor voltage |
| V2.7 | Heat Sink Temperature | | | °C | Temperature of heat sink. |
| V2.8 | DC-link Voltage | | | V | Actual value of measured DC-link voltage. |
| V2.9 | Frequency Reference | | | Hz | |
| V2.10 | Output Frequency | | | Hz | Output frequency to the motor |
| M3 System Menu | | | | | |
| Code | Name | Min | Max | Unit | Description |
| S3.3 Copy parameters | | | | | |
| P3.3.1 | Parameter sets | | | | 0 = Select 1 = Store user parameters 2 = Load user parameters 3 = Store factory parameters 4 = Load factory parameters 5 = Reset parameters 6 = Fault 7 = Wait 8 = OK |
| S3.5 Security (not used) | | | | | |
| P3.5.2 | Parameter lock | | | | 0 = Change Enabled 1 = Change Disabled |
| S3.6 Keypad settings | | | | | |
| P3.6.1 | Default page | | | | Display goes to Default page after Timeout time. If value 0 is selected, this feature is not active. Default value 2.10 "Output Frequency" |
| P3.6.3 | Timeout time | 0 | 65535 | s | Display goes to Default page after Timeout time. |
| S3.7 Hardware settings | | | | | |
| P3.7.2 | Fan control | | | | 0 = Continuous, default 1 = Temperature |
| P3.7.3 | | | | | Not used |
| P3.7.4 | | | | | Not used |
| S3.8 System info | | | | | |
| S3.8.1 Counters menu | | | | | |
| C3.8.1.1 | MWh counter | | KWh | | |
| C3.8.1.2 | Operating days Counter | | hh:mm:ss | | |
| C3.8.1.3 | Operating hours Counter | | hh:mm:ss | | |
| S3.8.2 Trip counters | | | | | |
| T3.8.2.1 | MWh trip counter | | KWh | | |
| P3.8.2.2 | Clear MWh trip counter | | | | |
| T3.8.2.3 | Operating days trip counter | | | | |
| T3.8.2.4 | Operating hours trip Counter | | hh:mm:ss | | |
| P3.8.2.5 | Clear operating time Counter | | | | |



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| S3.8.3 Software info | | | | |
|--|---------------------|--|--|--|
| I3.8.3.1 | Software package | | | |
| I3.8.3.2 | System SW version | | | |
| I3.8.3.3 | Firmware interface | | | |
| I3.8.3.4 | System load | | | |
| S3.8.4 Application info | | | | |
| A3.8.4.1 | Application | | | |
| A3.8.4.1.1 | Application id | | | |
| A3.8.4.1.2 | Application version | | | |
| A3.8.4.1.3 | Firmware interface | | | |
| S3.8.5 Hardware info | | | | |
| I3.8.5.2 | Unit voltage | | | |
| I3.8.5.3 | Brake chopper | | | |
| I3.8.5.4 | Brake resistor | | | |
| S3.8.6 Options | | | | |
| S3.8.6.1 | NXOPT | | | |
| E3.8.6.1.1 | Status | | | |
| E3.8.6.1.2 | Program version | | | |
| S3.9 (not used) | | | | |
| | | | | |
| S3.10 (not used) | | | | |
| | | | | |
| M4 Active faults | | | | |
| The memory of active faults can store the maximum of 10 faults in the order of appearance. | | | | |
| By pushing the button you will enter the Fault history section. | | | | |
| M5 Fault history | | | | |
| The fault memory can store a maximum of 5 faults in the order of appearance. The number of faults currently in the fault history is shown on the value line of the main page. The latest fault carries the indication H5.1, the second latest H5.2 etc. If there are 5 uncleared faults in the memory, the next occurring fault will erase the oldest from the memory. | | | | |
| Pressing the Enter button for about 2 to 3 seconds resets the whole fault history. | | | | |



When one of listed motors is selected, Parameters group G1.2.4, G1.2.5 and G1.2.6 are not viewable. Parameters group G1.2.4, G1.2.5 can be viewed after P1.2.2 is set back to 1 "free travel"



In parameter P2.3. there is one digit for each input. 1 = There is voltage in input = input is active, 0 = There is no voltage in input = input is not active





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6.2.1 Reverse Plugging

When opposite drive command is active while the inverter is operating, the deceleration/acceleration ramp can be shorter than the normal ramp. Reverse plugging function is “on” if the driving frequency > 30% of the “Max Freq” (not the “Motor Nom Freq”). Reverse plugging function goes “off state” in opposite direction to original direction when driving frequency > 95% of reference frequency. The value can be set between 50 to 100%. 100% corresponds that the ramp is the same as the normal ramp. 50% corresponds that the ramp is a half of the normal ramp. The default value is 80%.

6.2.2 Relay output

Inverter has one programmable relay output (ROA1) and one relay output for brake control (ROD1). Relay output functions for ROA1 are listed below.

| Par value | Name | Description |
|-----------|------------------|--|
| 0 | Not Used | |
| 1 | Fault | Relay is activated when fault is on. |
| 2 | Brake Control | External brake ON/OFF-control. Default value in relay output ROD1 (K7 control). |
| 3 | Run | Relay is activated when current is fed to motor. |
| 4 | Ready | Relay is activated when Drive is ready to operate. |
| 5 | Ready Inverted | Relay is activated when Drive is not ready to operate. |
| 6 | Fan | Relay is activated when DC-link voltage is above braking chopper operating level - 70V. Relay is closed for a minimum of 300s. |
| 7 | Emergency Stop | Relay is activated in case of F1 Overcurrent, F2 Overvoltage or F3 Earth Fault. Relay is deactivated when the power is switched off. |
| 8 | Reverse Plugging | Relay is activated when direction requested is different than direction of actual frequency. |
| 9 | At Speed | Relay is activated when ramp generator output has reached speed reference request. |
| 10 | S2 Active | Relay is activated when motor actual speed direction is S2. |
| 11 | Temp 1 | Relay contact is activated when temperature is 20°C (68F) or below. Relay is inactivate when temperature is 23°C (73F) or above. |
| 12 | Temp 2 | Relay contact is activated when temperature is 40°C (104F) or above. Relay is inactivate when temperature is 37°C (98F) or below. |

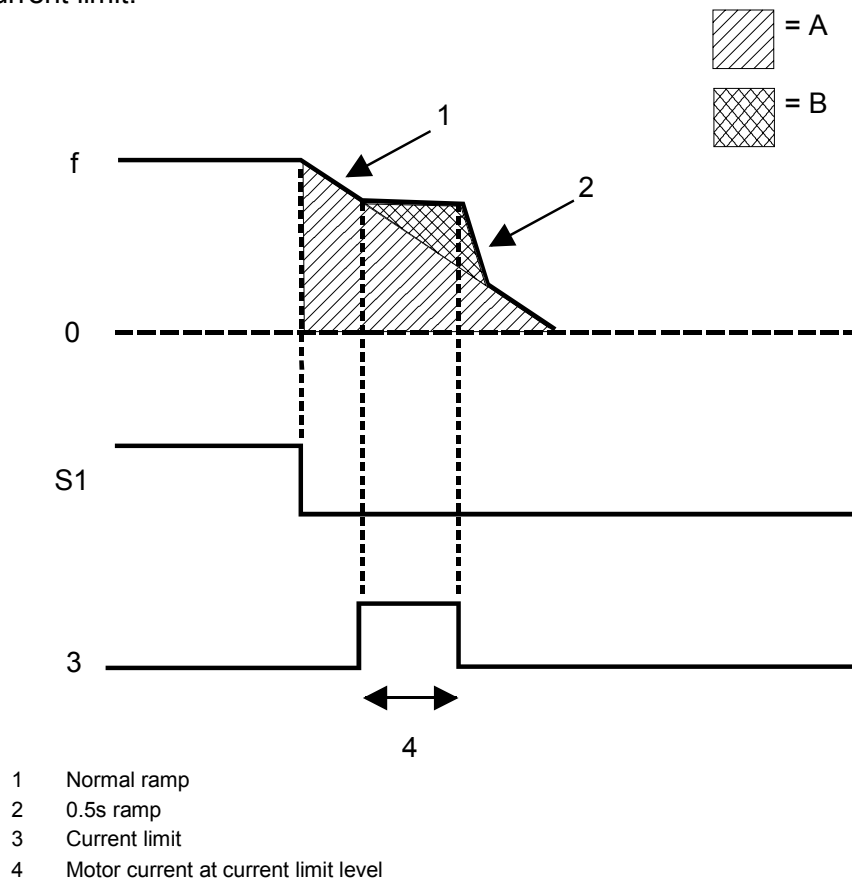


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6.2.3 Ramp stretching

The inverter allows stretching the ramp on the generating side. The ramp stretching is adjustable as percentage of nominal deceleration distance. The default stretch of the normal ramp is 40% of the nominal deceleration distance.

If the inverter cannot stop with the set ramp stretching, it will stop by brake and show fault code. F56 Generator side current limit.





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7 START-UP PROCEDURE

If any problems or malfunctions occur during the start-up, refer to *Chapter "Troubleshooting"*, to find out the reason. All problems must be solved before continuing.



Warning! High voltages inside device. Wait for at least five minutes after the supply voltage has been switched off before service actions. Display in operating condition (lights on) indicates a dangerous voltage on the DC-bus. When display turns off, the DC-bus voltage is about 100V. Note also that there is a dangerous voltage in the braking resistor always when the DC-bus is charged.



Do not connect any voltage to the output terminals (U, V, W). Otherwise, the inverter will be damaged.



The overload protection protects both the supply and the motor cables. The supply fuses provide short circuit protection.

7.1 Visual checks

- Check condition of cubicles.
- Check that serial number of the drive is the same as in delivery documents.
- Check the cabling to braking resistor.
- Check the cabling to motor, brake, thermistors (and speed sensor).
- Check motor type.
- Check the wire terminations in the motor connection box
- Check connections for motor thermistors/ thermostat and brake wear.
- Disconnect motor (U, V, W) and brake cables to prevent damage of inverter. Measure insulation resistance of brake coil and motor windings (each phase to ground).
- Re-connect motor and brake cables.

7.2 Checks before the first test run

- Check power supply voltage (nominal voltage +/- 10%).
- Check control voltage (nominal voltage +/- 10%).
- Make sure that run commands are off (pushbuttons / controller (master switch) at zero position).
- Turn on power from main switch and control voltage switch.
- Within about 1 second the control panel should have display.
- In a fault situation the red FAULT status indicator blinks and the display shows a fault code instead of frequency.
- Check that green RUN status indicator is off.
- Check that external connections and selected control parameters are according to application.

7.3 Check motor parameters

In most of cases parameters are properly set after factory tests and no adjustments are needed except for the parameters that depend on application. In case the factory has not had information about the motors, motor related parameters need to be adjusted with the following steps. Write down on the parameter list all the values that have been changed and at the end save parameters to User parameters, see Chapter "User parameters".



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7.3.1 Compact brake motors (MF06MA, MF06LA)

Enter motor nominal voltage to parameter P1.2.1.

Select correct motor type with parameter P1.2.2.

Enter number of motors to parameter P1.2.3.

Parameters in group G1.2.4. are not visible when motor type is selected with parameter P1.2.2. Values to those parameters are set automatically according the selected motor type.

7.3.2 Other motors

Enter motor nominal voltage to parameter P1.2.1.

Select "Free travel" with parameter P1.2.2. (value 1)

Enter motor nominal values to parameters P1.2.4.1. - P1.2.4.5.

Current parameters P1.2.4.2 - P1.2.4.4. has to be set to value of one motor multiplied with number of motors.

Finally, perform Autotuning. See chapter "Autotuning"

7.4 Test run without load

- Make sure that movement will not cause any danger to the environment or to the crane itself. Avoid driving close to the limit areas.
- Check limit switches manually if possible.
- Check the run commands on the display panel and correct the traveling direction. The arrow rotates clockwise if S1 is applied and counter-clockwise if S2 is applied.
- Drive direction S1 at minimum speed for 5 to 10 seconds. Accelerate to full speed. Run 5 to 10 seconds. Stop. Repeat the same in direction S2. Check the frequency display to make sure that the frequency changes through the whole operational frequency range from minimum to nominal speed.
- Check motor operation (acceleration, deceleration and braking): accelerate to full speed direction S1, change to full speed direction S2 and full speed direction S1 again and stop.
- Check limit switch functions: drive direction S1 slowly and check the limit switch operations. Re-check using full speed. Repeat the same check for direction S2.

7.5 Test run with load

- Make sure that movement will not cause any danger to the environment or to the crane itself.
- Drive in both directions at minimum and maximum speeds.

7.6 Test run with overload

If an overload test has to be performed during crane commissioning, minimum frequency should be raised for duration of the commissioning to 20Hz. Minimum frequency can be changed with parameters P1.1.4. After testing, minimum frequency should be changed back to its original value.

7.7 After the test run

- Record all parameter value changes in the parameter list.
- Make sure all remarks and setting values are recorded.

It is recommended to store the parameter settings in file User parameters, see *Chapter "User parameters"*.



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8 TROUBLESHOOTING



Warning! High voltages inside Frequency converter. Wait for at least five minutes after the supply voltage has been switched off before service actions. The display in the operating condition (lights on) indicates a dangerous voltage on the DC-bus. When display turns off, the DC-bus voltage is approximately 100V. Note also that there is always a dangerous voltage in the braking resistor when the DC-bus is charged.

8.1 Field repair actions

The purpose of troubleshooting and field repair actions is primarily to determine whether the drive or external devices in fact cause the problems. After that, the next step is to detect the possibly damaged components inside the drive. If any damage inside the drive is caused by the environment (motor failure, brake failure, power supply problems etc.) it is very important to repair/change faulty items to prevent reoccurring problems.

The best way to repair a faulty inverter is to replace it with a new one. If the fault can be located, it is also possible to replace some of the components. When replacing an inverter or a Control unit with a new one, the parameter list of the existing drive is needed so that the parameter settings can be copied to new the one.

8.2 Typical functional problems

- Inverter does not start when mains are connected.
Check mains voltage between terminal L1, L2 and L3
- Indicator "Ready" is on and indicator "Fault" is off, but motor does not run.
Check control mode selection
Check voltage at run command terminals
Check state of digital inputs from parameter V2.3
- Indicator "Ready" is on and indicator "Run" is on, but motor does not run.
Check motor cable connection
- Motor runs poorly
Check that load is not over nominal
Check that all cables are connected correctly and the junctions are reliable
Check that all motor dependant parameters are correct
Check the voltage of the slowdown limit switch input
Check state of digital inputs from parameter V2.3
Check that motor's brake opens completely
Check that minimum speed parameters do not have too small values
For travelling application: check u/f-curve tuning and/or Autotuning. If the main girder is new, it might be necessary to drive trolley several times with no load from end to end, before beginning of u/f-curve tuning and/or Autotuning.
- Some parameters are not accessible or changing is not possible
Check that password has value 2156
Check that parameter value is inside the limits
Parameter value can not be changed in RUN state
Parameter value change must be confirmed with "Enter" button

8.3 Inverter fault codes

If any of the following failures is found, the inverter displays the fault code and closes the mechanical brake causing the movement to stop. If several faults occur one after another, the latest one is displayed, the others are stored to fault history page.

When inverter fault supervision trips, the FAULT indicator turns on and the blinking fault code “Fx xx” (x= fault accounting number, xx = fault code number) appears on the display.

The drive includes an automatic fault reset operation; the fault code stays on the display until the fault is removed and the controller released back to 0-position. Some of the fault codes require to switch the power off before run is possible, for example F1 (overcurrent).

All faults are stored in the Fault History menu except F51 Stop-Limit, from there they can be seen if necessary. The fault history store the last 5 fault codes.

Fault code is at the right side of the display.

Example in picture: Fault code in fault history, F5.X. XX.

X = fault number, XX = Fault code



Example in picture: Active fault code, FX XX

X = fault number, XX = Fault code



| Fault code | Fault | Possible cause | Checking | A | B |
|------------|---------------|--|--|---|---|
| F 1 | Overcurrent | Inverter has measured too high current (over $4 \cdot I_N$ peak or over $2.8 \cdot I_N$ rms) in the motor output: sudden heavy load increase short circuit in the motor or cable not suitable motor wrong motor parameters | Reset: switch power off and restart after the lamps of display are off. Check: brake operation motor type and power rating parameters motor cable connection motor insulation motor loading | | X |
| F 2 | Overvoltage | DC-bus voltage has exceeded 135% maximum level, 911Vdc deceleration time is too short supply voltage raised $>1.35 \times U_n$ (high overvoltage spikes at mains or not sinusoidal wave form) | Reset has an additional 5s time delay. Check: adjust the deceleration time P1.1.3 longer measure main supply voltage level and wave form while not driving braking resistor cable braking resistor type and resistance braking chopper operation | | X |
| F 3 | Earth fault | Current measurement has sensed unbalance in motor phase currents. Supervision level is 5% of inverter nominal current not symmetric load insulation failure in the motor or the cable | Reset has an additional 5s time delay. Check: motor insulation motor cable insulation (phase-ground, phase-phase) | | X |
| F 6 | External Stop | ES signal inactive | Check: ES external connections Control mode selection P1.1.11 State of input DID5, V2.3. Thermal protection of motor is normally connected to | X | |



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| | | | | | |
|--------------|-------------------------------|---|---|---|---|
| | | | ES signal, check motor temperature. | | |
| F 8 | System fault | Component failure Faulty operation | Reset: switch power off and restart after the lamps of display are off. If the fault comes again, contact authorized service center. | X | |
| F 9 | Undervoltage | DC-bus voltage has dropped below 333Vdc mains supply voltage interrupted inverter fault can also cause an undervoltage trip external fault during run may cause an undervoltage trip | In case of temporary supply voltage break, reset the fault and start again. Check mains input. If mains supply is correct, an internal failure has occurred. Contact authorized service center. | X | |
| F 11 | Output phase supervision | Current supervision has sensed that at least one of the motor phases has no current | Check: motor cable connections measure motor phase currents and compare to display value | | X |
| F 13 | Inverter undertemperature | Temperature of heat sink is below acceptable operating level -10°C (14°F) | Check ambient temperature cubicle heating | X | |
| F 14 | Inverter overtemperature | Temperature of heat sink is over acceptable operating level +90°C (194°F). Overtemperature warning is issued when the heat sink temperature exceeds +85°C (185°F) | Check: ambient temperature inverter cooling fan operation cooling air flow through heat sink heat sink is not dirty | X | |
| F 16 | | Parameter P1.4.1 has value "1" or "2" | Change Parameter P1.4.1 to value "0" | | X |
| F 22 F 23 | EEPROM checksum fault | Parameter save error interference fault component failure (control unit) | After power off the inverter will automatically reset parameter settings. The drive does not work properly nor enable driving after this fault. Check: all parameter settings. +24V voltage output loading If the fault comes again, contact authorized service center. | | X |
| F 25 | Microprocessor watchdog-fault | interference fault component failure (control unit) | Reset: switch power off and restart after the lamps of display are off. If the fault comes again, contact service center. | X | |
| F 39 | Device removed | Option board removed. | Reset the fault Check option board connection | X | |
| F 40 | Device unknown | Unknown option board or drive. | Check board and drive type. | | X |
| F 41 | IGBT temperature | IGBT transistors is calculated to be over heated long duration overload lowered cooling high environment temperature | Reset: switch power off and restart after the lamps of keypad are off. Check: motor loading brake operation inverter heatsink inverter cooling fan operation environment temperature | | X |
| F 44 | Device changed | Option board changed. | Reset the fault | X | |
| F 45 | Device added | Option board added. | Reset the fault | X | |
| F 51 | Stop limit | S12 or S22 signal is inactive | Reset: keep controller at zero >300ms. Check control mode selection P1.1.11 Check the state of inputs DID4 and DID5, V2.3 Hoisting application: check Dold settings | X | |
| F 55 | Board fault | Option board is missing or not working | Reset: switch power off and restart after the lamps of display are off. Check: Option board | | X |
| F 56 | Generator side current limit | The inverter cannot stop with the set ramp stretching, it will stop by brake and show F56 Too short deceleration time | Reset has an additional 5 s time delay. Check: deceleration time | X | |
| F 60 | Parameter fault | "Motor selection" parameter P1.2.2 has value = "Not Used" | Download parameters again | | X |
| F 73 | Both drive commands active | S1 and S2 signals on over 500ms in same time The inverter stops according "Stop Function" parameter Short circuit in pendent cable | Check: digital I/O cabling | | X |

A = Can be done by the user

B = Can be done only by manufacturer authorized personnel



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9 TROUBLESHOOTING TABLE

If the drive doesn't work, but any fault doesn't found write down the following information before contacting to the supplier.

| GENERAL INFORMATION | |
|--|--|
| WORK NUMBER | |
| CUSTOMER REFERENCE | |
| DATE PUT IN OPERATION | |
| DATE OF FAILURE | |
| SHORT DESCRIPTION OF FAILURE, ERROR CODE | |

| INVERTER INFORMATION | | | |
|-------------------------|--|---------------------------|----|
| TYPE CODE | | ACCELERATION TIME, P1.1.2 | S |
| SERIALNUMBER | | DECELERATION TIME, P1.1.3 | S |
| CONTROL METHOD, P1.1.11 | | MIN FREQ, P1.1.4 | Hz |
| EP2 | | MAX FREQ, P1.1.5 | Hz |
| EP3 | | | |
| MS | | | |

| MOTOR INFORMATION | | | |
|-------------------|--|-------------------|---|
| TYPE CODE | | NOMINAL VOLTAGE | S |
| SERIALNUMBER | | NOMINAL CURRENT | S |
| | | NOMINAL FREQUENCY | |
| | | NOMINAL SPEED | |
| | | POWER FACTOR | |

| MEASURED VALUES | | | | | | | |
|--------------------------|--------------|--------------|--------------|-----------------|----------|----------|----------|
| INVERTER | | | | MOTOR | | | |
| VOLTAGE PHASE-TO-PHASE | L1-L2 Vac | L1-L3 Vac | L2-L3 Vac | NOMINAL CURRENT | U-V Ω | V-W Ω | W-U Ω |
| VOLTAGE PHASE-TO-GROUND | L1 Vac | L2 Vac | L3 Vac | | | | |
| MEASURED CONTROL VOLTAGE | V | | | | | | |



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10SERVICE

The drive does not require regular maintenance. However the following actions are recommended:

- Check fault history
Find out reasons of possible faults
Clear the fault history
- Clean the heat sink
Prevent the dust to spread inside cubicles
Lock the fans before blowing compressed air
- Check that there are no abnormal noises coming from the cooling fan
- Tighten all screws and connectors
- Clean dust from PC-boards



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11SPARE PARTS LIST



Inverter D2S includes only one I/O Extension board slot.

| POS | DESCRIPTION | NAME | ID | REMARKS | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 | 101 | 102 | 103 | 104 | 105 | 106 | 107 | 108 | 109 | 110 | 111 | 112 | 113 | 114 | 115 | 116 | 117 | 118 | 119 | 120 | 121 | 122 | 123 | 124 | 125 | 126 | 127 | 128 | 129 | 130 | 131 | 132 | 133 | 134 | 135 | 136 | 137 | 138 | 139 | 140 | 141 | 142 | 143 | 144 | 145 | 146 | 147 | 148 | 149 | 150 | 151 | 152 | 153 | 154 | 155 | 156 | 157 | 158 | 159 | 160 | 161 | 162 | 163 | 164 | 165 | 166 | 167 | 168 | 169 | 170 | 171 | 172 | 173 | 174 | 175 | 176 | 177 | 178 | 179 | 180 | 181 | 182 | 183 | 184 | 185 | 186 | 187 | 188 | 189 | 190 | 191 | 192 | 193 | 194 | 195 | 196 | 197 | 198 | 199 | 200 | 201 | 202 | 203 | 204 | 205 | 206 | 207 | 208 | 209 | 210 | 211 | 212 | 213 | 214 | 215 | 216 | 217 | 218 | 219 | 220 | 221 | 222 | 223 | 224 | 225 | 226 | 227 | 228 | 229 | 230 | 231 | 232 | 233 | 234 | 235 | 236 | 237 | 238 | 239 | 240 | 241 | 242 | 243 | 244 | 245 | 246 | 247 | 248 | 249 | 250 | 251 | 252 | 253 | 254 | 255 | 256 | 257 | 258 | 259 | 260 | 261 | 262 | 263 | 264 | 265 | 266 | 267 | 268 | 269 | 270 | 271 | 272 | 273 | 274 | 275 | 276 | 277 | 278 | 279 | 280 | 281 | 282 | 283 | 284 | 285 | 286 | 287 | 288 | 289 | 290 | 291 | 292 | 293 | 294 | 295 | 296 | 297 | 298 | 299 | 300 | 301 | 302 | 303 | 304 | 305 | 306 | 307 | 308 | 309 | 310 | 311 | 312 | 313 | 314 | 315 | 316 | 317 | 318 | 319 | 320 | 321 | 322 | 323 | 324 | 325 | 326 | 327 | 328 | 329 | 330 | 331 | 332 | 333 | 334 | 335 | 336 | 337 | 338 | 339 | 340 | 341 | 342 | 343 | 344 | 345 | 346 | 347 | 348 | 349 | 350 | 351 | 352 | 353 | 354 | 355 | 356 | 357 | 358 | 359 | 360 | 361 | 362 | 363 | 364 | 365 | 366 | 367 | 368 | 369 | 370 | 371 | 372 | 373 | 374 | 375 | 376 | 377 | 378 | 379 | 380 | 381 | 382 | 383 | 384 | 385 | 386 | 387 | 388 | 389 | 390 | 391 | 392 | 393 | 394 | 395 | 396 | 397 | 398 | 399 | 400 | 401 | 402 | 403 | 404 | 405 | 406 | 407 | 408 | 409 | 410 | 411 | 412 | 413 | 414 | 415 | 416 | 417 | 418 | 419 | 420 | 421 | 422 | 423 | 424 | 425 | 426 | 427 | 428 | 429 | 430 | 431 | 432 | 433 | 434 | 435 | 436 | 437 | 438 | 439 | 440 | 441 | 442 | 443 | 444 | 445 | 446 | 447 | 448 | 449 | 450 | 451 | 452 | 453 | 454 | 455 | 456 | 457 | 458 | 459 | 460 | 461 | 462 | 463 | 464 | 465 | 466 | 467 | 468 | 469 | 470 | 471 | 472 | 473 | 474 | 475 | 476 | 477 | 478 | 479 | 480 | 481 | 482 | 483 | 484 | 485 | 486 | 487 | 488 | 489 | 490 | 491 | 492 | 493 | 494 | 495 | 496 | 497 | 498 | 499 | 500 | 501 | 502 | 503 | 504 | 505 | 506 | 507 | 508 | 509 | 510 | 511 | 512 | 513 | 514 | 515 | 516 | 517 | 518 | 519 | 520 | 521 | 522 | 523 | 524 | 525 | 526 | 527 | 528 | 529 | 530 | 531 | 532 | 533 | 534 | 535 | 536 | 537 | 538 | 539 | 540 | 541 | 542 | 543 | 544 | 545 | 546 | 547 | 548 | 549 | 550 | 551 | 552 | 553 | 554 | 555 | 556 | 557 | 558 | 559 | 560 | 561 | 562 | 563 | 564 | 565 | 566 | 567 | 568 | 569 | 570 | 571 | 572 | 573 | 574 | 575 | 576 | 577 | 578 | 579 | 580 | 581 | 582 | 583 | 584 | 585 | 586 | 587 | 588 | 589 | 590 | 591 | 592 | 593 | 594 | 595 | 596 | 597 | 598 | 599 | 600 | 601 | 602 | 603 | 604 | 605 | 606 | 607 | 608 | 609 | 610 | 611 | 612 | 613 | 614 | 615 | 616 | 617 | 618 | 619 | 620 | 621 | 622 | 623 | 624 | 625 | 626 | 627 | 628 | 629 | 630 | 631 | 632 | 633 | 634 | 635 | 636 | 637 | 638 | 639 | 640 | 641 | 642 | 643 | 644 | 645 | 646 | 647 | 648 | 649 | 650 | 651 | 652 | 653 | 654 | 655 | 656 | 657 | 658 | 659 | 660 | 661 | 662 | 663 | 664 | 665 | 666 | 667 | 668 | 669 | 670 | 671 | 672 | 673 | 674 | 675 | 676 | 677 | 678 | 679 | 680 | 681 | 682 | 683 | 684 | 685 | 686 | 687 | 688 | 689 | 690 | 691 | 692 | 693 | 694 | 695 | 696 | 697 | 698 | 699 | 700 | 701 | 702 | 703 | 704 | 705 | 706 | 707 | 708 | 709 | 710 | 711 | 712 | 713 | 714 | 715 | 716 | 717 | 718 | 719 | 720 | 721 | 722 | 723 | 724 | 725 | 726 | 727 | 728 | 729 | 730 | 731 | 732 | 733 | 734 | 735 | 736 | 737 | 738 | 739 | 740 | 741 | 742 | 743 | 744 | 745 | 746 | 747 | 748 | 749 | 750 | 751 | 752 | 753 | 754 | 755 | 756 | 757 | 758 | 759 | 760 | 761 | 762 | 763 | 764 | 765 | 766 | 767 | 768 | 769 | 770 | 771 | 772 | 773 | 774 | 775 | 776 | 777 | 778 | 779 | 780 | 781 | 782 | 783 | 784 | 785 | 786 | 787 | 788 | 789 | 790 | 791 | 792 | 793 | 794 | 795 | 796 | 797 | 798 | 799 | 800 | 801 | 802 | 803 | 804 | 805 | 806 | 807 | 808 | 809 | 810 | 811 | 812 | 813 | 814 | 815 | 816 | 817 | 818 | 819 | 820 | 821 | 822 | 823 | 824 | 825 | 826 | 827 | 828 | 829 | 830 | 831 | 832 | 833 | 834 | 835 | 836 | 837 | 838 | 839 | 840 | 841 | 842 | 843 | 844 | 845 | 846 | 847 | 848 | 849 | 850 | 851 | 852 | 853 | 854 | 855 | 856 | 857 | 858 | 859 | 860 | 861 | 862 | 863 | 864 | 865 | 866 | 867 | 868 | 869 | 870 | 871 | 872 | 873 | 874 | 875 | 876 | 877 | 878 | 879 | 880 | 881 | 882 | 883 | 884 | 885 | 886 | 887 | 888 | 889 | 890 | 891 | 892 | 893 | 894 | 895 | 896 | 897 | 898 | 899 | 900 | 901 | 902 | 903 | 904 | 905 | 906 | 907 | 908 | 909 | 910 | 911 | 912 | 913 | 914 | 915 | 916 | 917 | 918 | 919 | 920 | 921 | 922 | 923 | 924 | 925 | 926 | 927 | 928 | 929 | 930 | 931 | 932 | 933 | 934 | 935 | 936 | 937 | 938 | 939 | 940 | 941 | 942 | 943 | 944 | 945 | 946 | 947 | 948 | 949 | 950 | 951 | 952 | 953 | 954 | 955 | 956 | 957 | 958 | 959 | 960 | 961 | 962 | 963 | 964 | 965 | 966 | 967 | 968 | 969 | 970 | 971 | 972 | 973 | 974 | 975 | 976 | 977 | 978 | 979 | 980 | 981 | 982 | 983 | 984 | 985 | 986 | 987 | 988 | 989 | 990 | 991 | 992 | 993 | 994 | 995 | 996 | 997 | 998 | 999 | 1000 | 1001 | 1002 | 1003 | 1004 | 1005 | 1006 | 1007 | 1008 | 1009 | 1010 | 1011 | 1012 | 1013 | 1014 | 1015 | 1016 | 1017 | 1018 | 1019 | 1020 | 1021 | 1022 | 1023 | 1024 | 1025 | 1026 | 1027 | 1028 | 1029 | 1030 | 1031 | 1032 | 1033 | 1034 | 1035 | 1036 | 1037 | 1038 | 1039 | 1040 | 1041 | 1042 | 1043 | 1044 | 1045 | 1046 | 1047 | 1048 | 1049 | 1050 | 1051 | 1052 | 1053 | 1054 | 1055 | 1056 | 1057 | 1058 | 1059 | 1060 | 1061 | 1062 | 1063 | 1064 | 1065 | 1066 | 1067 | 1068 | 1069 | 1070 | 1071 | 1072 | 1073 | 1074 | 1075 | 1076 | 1077 | 1078 | 1079 | 1080 | 1081 | 1082 | 1083 | 1084 | 1085 | 1086 | 1087 | 1088 | 1089 | 1090 | 1091 | 1092 | 1093 | 1094 | 1095 | 1096 | 1097 | 1098 | 1099 | 1100 | 1101 | 1102 | 1103 | 1104 | 1105 | 1106 | 1107 | 1108 | 1109 | 1110 | 1111 | 1112 | 1113 | 1114 | 1115 | 1116 | 1117 | 1118 | 1119 | 1120 | 1121 | 1122 | 1123 | 1124 | 1125 | 1126 | 1127 | 1128 | 1129 | 1130 | 1131 | 1132 | 1133 | 1134 | 1135 | 1136 | 1137 | 1138 | 1139 | 1140 | 1141 | 1142 | 1143 | 1144 | 1145 | 1146 | 1147 | 1148 | 1149 | 1150 | 1151 | 1152 | 1153 | 1154 | 1155 | 1156 | 1157 | 1158 | 1159 | 1160 | 1161 | 1162 | 1163 | 1164 | 1165 | 1166 | 1167 | 1168 | 1169 | 1170 | 1171 | 1172 | 1173 | 1174 | 1175 | 1176 | 1177 | 1178 | 1179 | 1180 | 1181 | 1182 | 1183 | 1184 | 1185 | 1186 | 1187 | 1188 | 1189 | 1190 | 1191 | 1192 | 1193 | 1194 | 1195 | 1196 | 1197 | 1198 | 1199 | 1200 | 1201 | 1202 | 1203 | 1204 | 1205 | 1206 | 1207 | 1208 | 1209 | 1210 | 1211 | 1212 | 1213 | 1214 | 1215 | 1216 | 1217 | 1218 | 1219 | 1220 | 1221 | 1222 | 1223 | 1224 | 1225 | 1226 | 1227 | 1228 | 1229 | 1230 | 1231 | 1232 | 1233 | 1234 | 1235 | 1236 | 1237 | 1238 | 1239 | 1240 | 1241 | 1242 | 1243 | 1244 | 1245 | 1246 | 1247 | 1248 | 1249 | 1250 | 1251 | 1252 | 1253 | 1254 | 1255 | 1256 | 1257 | 1258 | 1259 | 1260 | 1261 | 1262 | 1263 | 1264 | 1265 | 1266 | 1267 | 1268 | 1269 | 1270 | 1271 | 1272 | 1273 | 1274 | 1275 | 1276 | 1277 | 1278 | 1279 | 1280 | 1281 | 1282 | 1283 | 1284 | 1285 | 1286 | 1287 | 1288 | 1289 | 1290 | 1291 | 1292 | 1293 | 1294 | 1295 | 1296 | 1297 | 1298 | 1299 | 1300 | 1301 | 1302 | 1303 | 1304 | 1305 | 1306 | 1307 | 1308 | 1309 | 1310 | 1311 | 1312 | 131 |
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12DRAWINGS

12.1 Description of terminals and wirings

The control unit of the frequency converter is integrated to the power unit in 002 and it is separated in bigger models. Control board and additional I/O board (NXOPTB9) connections are listed below.

Terminals 003F – 011F

| No | Name | Description, signal level |
|------|------|---|
| | PE | |
| L1 | L1 | Power supply, phase 1 |
| L2 | L2 | Power supply, phase 2 |
| L3 | L3 | Power supply, phase 3 |
| B+ | R+ | Braking resistor |
| R- | R- | Braking resistor |
| U/T1 | U/T1 | Motor output, phase 1 |
| V/T2 | V/T2 | Motor output, phase 2 |
| W/T3 | W/T3 | Motor output, phase 3 |
| | | |
| 31 | BD1 | DC brake supply 1 |
| 32 | BD2 | DC brake supply 2 |
| | | |
| 4 | T12 | Reserved for thermistors connections |
| 5 | OLE | External control voltage, 48/115/230Vac |
| 6 | OLE | External control voltage, 48/115/230Vac |
| 7 | K7-5 | Free NO-contact of K7 |
| 8 | K7-6 | Free NO-contact of K7 |
| 36 | ONE | Neutral of external control voltage OLE |
| 38 | S1 | Direction 1 run command |
| 39 | S2 | Direction 2 run command |
| 40 | DID3 | Multi Function Input |
| 41 | DID4 | Multi Function Input |
| 42 | DID5 | Multi Function Input |
| 47 | OLE | External control voltage, 48/115/230Vac |
| | | |
| | PE | |

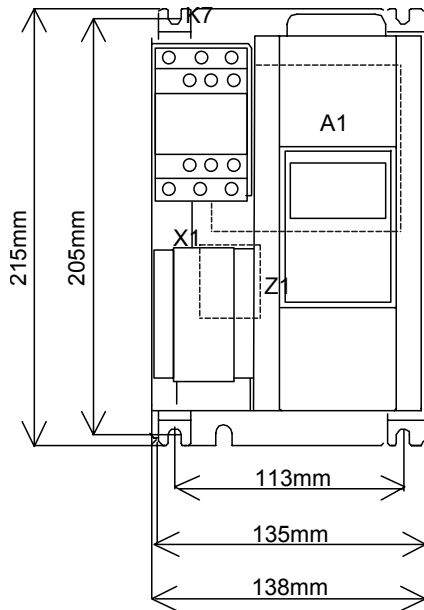
Terminals 015 – 022

| No | Name | Description, signal level |
|----|------|---|
| | PE | |
| 31 | BD1 | DC brake supply 1 |
| 32 | BD2 | DC brake supply 2 |
| | | |
| 4 | T12 | Reserved for thermistors connections |
| 5 | OLE | External control voltage, 48/115/230Vac |
| 6 | OLE | External control voltage, 48/115/230Vac |
| 7 | K7-5 | Free NO-contact of K7 |
| 8 | K7-6 | Free NO-contact of K7 |
| 36 | ONE | Neutral of external control voltage OLE |
| 38 | S1 | Direction 1 run command |
| 39 | S2 | Direction 2 run command |
| 40 | DID3 | Multi Function Input |
| 41 | DID4 | Multi Function Input |
| 42 | DID5 | Multi Function Input |
| 47 | OLE | External control voltage, 48/115/230Vac |
| | | |
| | PE | |

12.2 Layouts, dimensions and weights

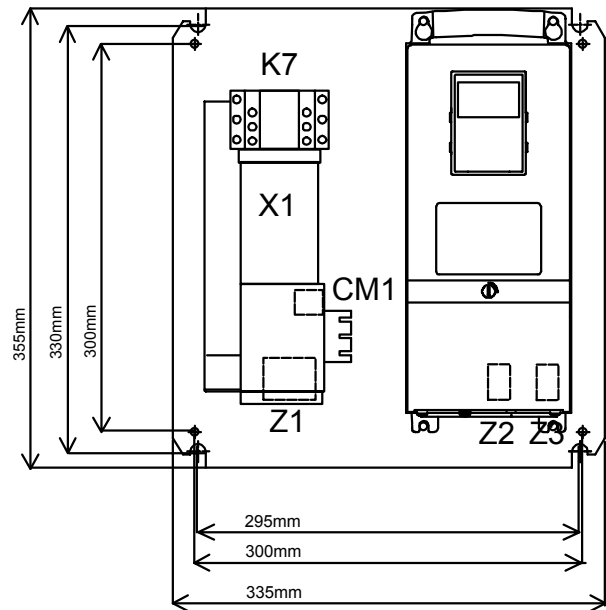
002F

Weight 3kg (7 lbs)



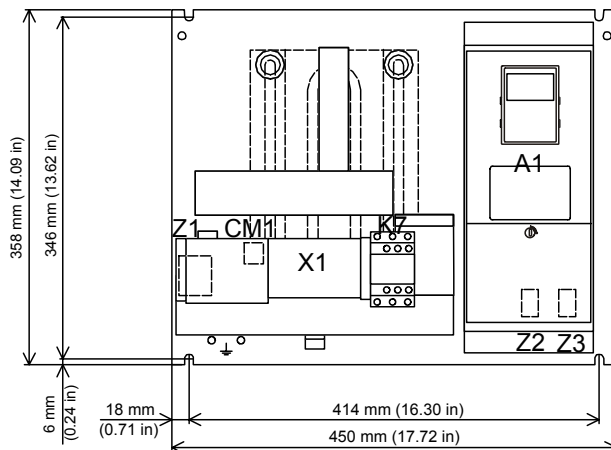
003F - 004F AW

Weight 11kg (24 lbs)



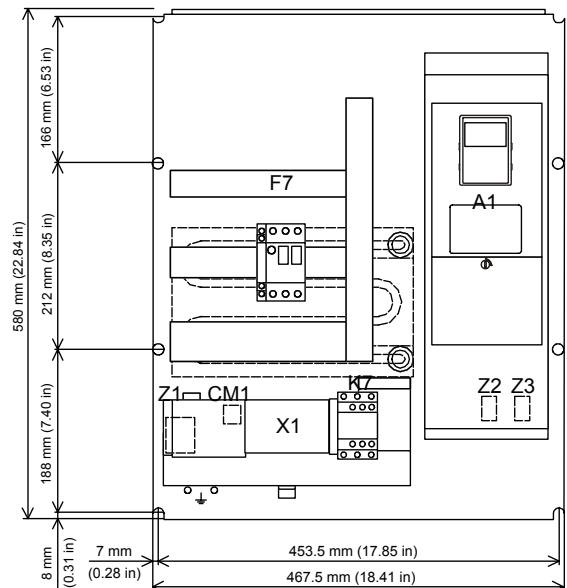
003F - 004F B0

Weight 13 kg (29 lbs)



005F B0

Weight 22 kg (49 lbs)

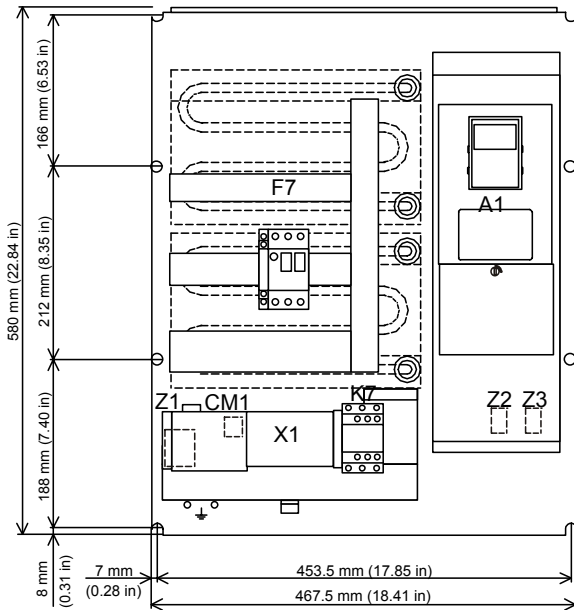




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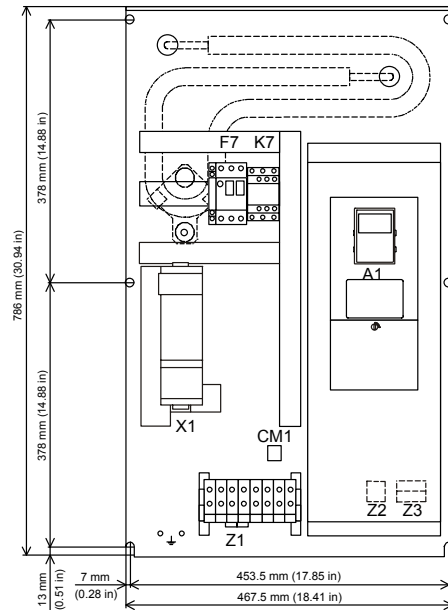
007F – 011F B0

Weight 22 kg (49 lbs)



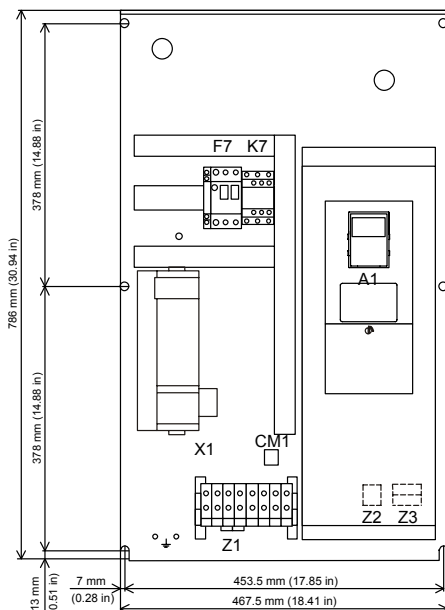
015F B0

Weight 31 kg (68 lbs)



018F – 022F B0

Weight 31kg (68 lbs)





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12.2.1 Internal wirings

| PE | A | B | C | D | Other single wires | Screened cables |
|--|--|--|--|--|---|--|
| 002F – 011F 2.5 mm ² AWG 14 | 002F – 011F 2.5 mm ² AWG 14 | 002F – 018F 2.5 mm ² AWG 14 | 002F – 022F 2.5 mm ² AWG 14 | 002F – 022F 1.5 mm ² AWG 16 | 002F – 022F 0.75 mm ² AWG 20 | 002F – 022F 8 x 0.5 mm ² 8 x AWG 20 |
| 015F-018F 6 mm ² AWG 10 | 015F 6 mm ² AWG 10 | 022F 6 mm ² AWG 10 | | | | |
| 022F 10 mm ² AWG 8 | 022F 10 mm ² AWG 8 | | | | | |

12.2.2 Wiring colours

| Single wires | | Screened cable board A | | Screened cable board C | |
|--------------|--------------|------------------------|--------|------------------------|--------|
| PE | Green-Yellow | PUR | Grey | EA+ | Grey |
| A | Black | +15V | Pink | EA- | Pink |
| C | Black | AIN1+ | Green | EB+ | Green |
| ONE | White | AIN2+ | Yellow | EB- | Yellow |
| Others | Red | AIN- | Blue | +24V | Brown |
| | | AOUT2 | Red | 0V | White |
| | | 0V | White | | |
| | | +24V | Brown | | |

12.3 Electrical diagrams

